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"All I ask is that, in the midst of a murderous world,
we agree to reflect on murder and make a choice."

Albert Camus
Neither Victims Nor Executioners

Fifty Years of US Nuclear Resistance

In August 1945, the mushroom clouds over Japan revealed to Gordon Maham the purpose of his secret government engineering job. He resigned from the Manhattan Project in protest, thus losing his draft exemption. Refusing post-war conscription, Maham was arrested and jailed for three yean as a conscientious objector.

In California, conscientious objector Bent Andersen was at the Civilian Public Service camp in Minersvillc doing alternative service, when he heard about the atomic bombs dropped on Hiroshima and Nagasaki. He left the camp and hitchhiked across the country, distributing leaflets as he went, which read in part, "Now is the time for the people of America to cry out that the first atomic bombs in history shall be the last! That war be waged no more! Anything less is moral and physical suicide." He was later arrested and imprisoned.

These acts of conscience ushered in the first SO years of anti-nuclear civil disobedience.

Organised non-violent resistance began in 1955, when Catholic Workers and other pacifists publicly refused to co-operate with civil defence drills in New York city. From this action a series of civil disobedience campaigns blossomed in the late 1950's. People were arrested at nuclear test sites in Nevada, the Pacific and Africa; missile bases in Cheyenne and Omaha; missile submarine shipyards in Connecticut; and California's Lawrence Livermore Laboratory, where the H-bomb was developed. Prison terms of six months were not uncommon and resistors were subject to public harassment and redbaiting.

Civil disobedience for nuclear disarmament faded along with the Ban the Bomb movement after above ground nuclear tests were banned in 1963. France's refusal to join the ban, and continued atmospheric testing in the Pacific, gave birth to the group Greenpeace in 1970. Like the Golden Rule and Phoenix voyages of the late 1950's, Greenpeace ships sailed into the South Pacific to disrupt scheduled French tests, and protest US nuclear tests in the Aleutian Islands.

Mass nuclear disarmament actions paralleled the growth of anti-nuclear power civil disobedience in the late *1970's.* Nuclear power plants from Scabrook, New Hampshire on the Atlantic coast to Diablo Canyon in California on the Pacific were sites of civil disobedience actions large and small. Participatory organising styles for non-violent direct actions featuring decision making by consensus were developed building on and moving beyond the practices of the civil-rights and the anti-war movements.

In 1978, organisers of the first national demonstration at the Rocky Flats plutonium processing plant near Denver planned a symbolic blockade of the railroad tracks to follow the legal demonstration. With participants from around the country, the action spontaneously grew into more than a year of resistance that overwhelmed local courts with hundreds of arrests. The encampment of the railroad tracks that served as springboard for repeated blockades preceded a wave of such resistance-oriented peace camps on both sides of the Atlantic in the 1980s.

Civil disobedience campaigns and faith based resistance communities were re-emerging on both coasts and in the missile fields of the mid-west. By the time deployment of Cruise and Pershing missiles in Europe was punctuated with the "winnable nuclear war" rhetoric of the Reagan administration, a widespread network of such communities and campaigns was active.

Since 1980, this movement of conscience in action has resulted, in the United States, in some 47,000 anti-nuclear arrests during at least 1,800 actions at more than 250 different sites. Resisters have been jailed for entering military bases, sitting-in at corporate and government offices, praying at nuclear weapons laboratories; blockading trucks and trains, nuclear power plants and nuclear dump sites; damaging weapons components and deployment systems in biblically-based "Plowshares" actions; and infiltrating test sites to impede actual nuclear weapons tests. Thousands have been imprisoned for a few days, hundreds for a month or more and dozens for one or more years.

As the nuclear age passes the half-century mark, direct action for nuclear disarmament continues, targeting advanced weapons and first-use strategies. A resurgence of resistance at nuclear power plants has also begun in mid 1990s, as ageing plants show risky signs of wear. The industry's production of irradiated nuclear fuel rods, the most dangerous of radioactive wastes, has begun to exceed safe storage capacity at many plants in the US and other countries, spurring citizen action and concern at sites across the country.

As we look to the challenges of the next 50 years, it is with great appreciation and respect that we remember the actions of so many people who have paved the way before us, showing us with their examples and their lives an active and conscientious response to the nuclear age.

The Nuclear Resistor July 7,1995

From the Editor's

CON-fusion prevails

Recently it seems, on one of his periodic visits abroad, Prime Minister Shri Narasimha Rao visited a fusion research laboratory and was suitably impressed. Taking advantage of his "good mood" a proposal for fusion research in India was mooted to him and grants worth Rs. 750 crores, sanctioned

The real horror of this story lies not in the fact that obscenely huge amount of money is being wasted; (it definitely is and not only in such esoteric activity as fusion); but that the scientific community considers this darbari style of functioning as perfectly normal and there is not a whimper of protest. Perhaps they feel that let the nucleocrats get away with their loot. Our time too would come. Even self-interest, which would dictate that the country's research kitty is by no means unlimited, and Rs. 750 crorcs not chicken feed, seems absent.

It is another issue altogether that the nucleocrats who have performed this fabulous heist have a long record of sterling non-performance when it comes to actually delivering what they promise. Even a cursory look at the operational record of nuclear power plants in the country would bear this out.

Fusion research is special, for it is not only our nucleocrats but everybody else's as well who love it since this black holes just gobbles huge amounts of resources and no energy ever need come out. Even countries with a fifty year tradition of fusion research, have nothing to show for their years of effort except futuristic labs to impress gullible visiting Prime Ministers. The present long term projections of the US Department of Energy regarding an operational commercial fusion reactor predict the possibility not before 2040. University of Maryland physicist, Robert Parks observes: "For years, we joked that fusion was 30 years away and always will be. Now most scientists say it is 50 or 60 years away."

Fire Derails Japanese Fast Breeder

On December 8, the Fast Breeder Reactor at Monju in Japan had an accident involving a leak of sodium coolant. Approximately four tones, of sodium leaked from the secondary cooling system. No leak of radiation was detected This was the largest leak ever recorded from the piping of operating reactor anywhere in the world

On December 11, the Fukui perfectural officials and later STA (Science and Technology Agency) officials along with PNC (power Reactor and Nuclear Fuel Development Corp.) staff surveyed the room where the leak occurred They concluded that the leak's source was a defective weld in a temperature probe attaching it to one of the 55 cm main secondary lines. The welding had been done in 1991 during remodelling of the whole loop due to a design fault

Video pictures show the extent of the damage. Sodium oxide and sodium hydroxide deposits were found mostly under and around the area of the defective tube but also throughout the room as well. This suggests that the sodium-water reaction was vigorous and lasted for hours spreading the reaction products everywhere.

Some steel structures showed evidence of melting, indicating that the sodium had caught fire reaching temperatures in excess of 1500 degrees centigrade. The video pictures of the room together with theoretical considerations strongly suggest that it was a spray fire, one of the most feared types of sodium reaction. This runs contrary to PNC's initial statement to the effect that; "a minor leakage in the secondary sodium loop caused some fumes."

In the course of the accident, the operators deviated repeatedly from standard operating procedure and were dangerously slow in reacting. Despite clear evidence of a leak, the operators took twelve minutes to respond. Even then, they slowly coasted the reactor down rather than implementing an immediate shutdown as standard operating procedure requires. On the second day after the leakage, PNC team entered the room and took video pictures. But the pictures released to the press showed only a corner of the room with intact pipes and a small amount of leaked sodium. This was a blatant attempt to play down the seriousness of the accident. In reality the damage was extensive with melted steel structures and reaction products spread throughout the room. This only came to the light after the perfectural survey team took and released the video pictures two days later.

Sodium and Air: A Dangerous Mix

Nuclear experts like liquid sodium as a coolant due to its high conductivity and low neutron absorbtion properties. Sodium in contact with either air or water causes an explosive reaction. Instead of abjuring industrial scale use of such dangerous materials, nucleocrats feel that the sweetness of the technological challenge is well worth the risk of blowing up whole populations.

PNC and STA now plan to drain the sodium and investigate the cause of the accident But draining the sodium is not an easy job and nobody knows how long the clean-up work will take. All the welding will need to be checked This can take a long time. Besides, Fukui Prefecture Government and other local governments will probably resist the restart of Monju. Tukio Kurita, the governor of Fukui Prefecture, has lodged a protest with Prime Minister Tomichi Murayama demanding that the government suspend its plans for Monju.

This fiasco has further corroborated what the anti-nuclear movement had been saying particularly against Monju and Japan's plutonium policy.

Jinzaburo Takagi: Citizens' Nuclear

Implications far India

As it happens, India's uranium reserves are sparse and usually of poor quality ore. The Indian (pie in the sky) nuclear programme is, and has always been, predicated to the proposition that fast breeder reactors would work and produce large quantities of plutonium in the near future. Thus, the repeated failures of fast breeders in both France and Japan, are of special concern to Indian nucleocrats who can see their dreams of continued government largesse slowly dissolving. It is perhaps for this reason that they have of late become more interested in fusion rather than fission. Since, nobody anywhere has got any working model of a fusion power generator, one can safely work in this 'frontier' area, crores can be spent, with no awkward questions asked regarding

performance.

Memories of Hiroshima

I was sixteen years old in the summer of 1945. In June, I had completed grade ten, and would enter grade eleven in September. I remember well the invasion of Normandy and the end of the European War. A young girl who lived two doors from my home had married her childhood sweetheart, a young neighbourhood boy in April 1945, and he was sent overseas almost immediately with the US army. His first battle was the invasion of Normandy, and he died on the beachhead. His young pregnant wife was devastated by the news. The pain of invasion could be felt throughout the neighbourhood, as we saw the build-up towards the invasion of Japan. Remember, we had heard horrible stories of the fighting in the Pacific Islands, most recently at Iwo Jima and Okinawa.

Then on 6 August 1945, the President announced that the US had dropped a new and awesome bomb on Hiroshima, and this might make it unnecessary to invade Japan. On August 9, a second bomb was dropped on Nagasaki. We were told that Japan's military ship building was the target. Then Japan surrendered and there would be no second bloody invasion to end the Pacific War. Everyone went crazy with celebration. My brother went to our Church and he, together with another boy, rang the Church bells for twenty minutes straight, until they were both exhausted. All of the Church bells in the city were ringing, and the people were out in the streets singing and laughing with joy. The boys were coming home. The war was over!

During the war there were many patriotic demands made on us, like rationing of food in short supply or needed by the troops. We also wrote letters to boys in service. I took on a slightly different type of letter writing. I wrote to boys who were conscientious objectors, who refused to kill. This was a very patriotic war and conscientious objectors were treated like dirt in the military. They had to put in their time in the service, but were given the most disagreeable jobs the military could find. I undertook to support them and try to keep up their morale. Killing, and what I understood as "bully power" merely biased the post-war negotiating process where the real decisions which carved out future relationships were made. The strongest, not the most just, got to "lay down the law." This merely set the stage for the next war, as the loser tried to build up the power to confront his oppressor.

On August 15, 1945, as all the neighbourhood was celebrating, my mother was strangely quiet. As she prepared the supper, I watched her stir the soup and keep repeating: "They should not have done it. They should not have done it." These words still haunt me. They were correct, but I do not know how my Mother knew, because the propaganda was so strong at the time.

My father served on the Financial Advisory Board of our Church. During the late 1940's, when there was a boom in the uranium mining industry, the Church wanted to invest in God's Lake Uranium Mining Company in Canada. My father strongly objected to this, and I heard him talking about it at home. Eventually, the Church withdrew its proposal and did not invest in the industry. There were no nuclear power plants at the time, so, as I now know, the only use for that uranium was bombs. Again I do not know how my father knew this or why he so vehcmently opposed this industry. He was a business man himself, the President of the Standard Mirror Company, which produced most of the automobile mirrors used in the Detroit car industry.

My mother was right 50 years ago. They should not have done it. My father was right when he said to leave uranium in the ground! I think that I am now right to call for an end to the lying and destructiveness of this industry which would steal from us the future life and health of our planet!

Dr. Rosalie Bertell

At the time, I was a ten year old living on the other end of the nuclear chain reaction in the federally planned city of Richland. Richland was home to the workers and families at the Hanford Engineering Works, a plutonium making facility 30 miles up the Columbia River.

We were elated when we heard the news of the bombing. People came out into the streets and raised a cheer: kids jumped around, did cartwheels, shadow-boxed each other. We had finally taught those Japs a lesson!

Trinity test bomb and Fat Man—the bomb which was dropped on Nagasaki—were plutonium bombs; therefore my dad's fingerprint's, so to speak, were on both.

Mervyn Witherup, my father, died on May 12, 1988 aged *77*. He died of prostrate cancer that had spread to his bone marrow. The prostrate is one of the organs that collects radionuclides. I have no doubt that Hanford killed my father. However, this is an issue which divides our family. My mother is very sure that work at Hanford did not cause her husbands cancer.

A pollster would find that most citizens in the area around Hanford, do not think that the radioactive and

chemical wastes pose any problems to heath. These communities have lived basically off the government teat for fifty years—and where you draw your paycheque shapes your politics. Richland High School is home to Richland Bombers whose logo is a mushroom cloud.

Although it would be political suicide for President Clinton to apologise in the name of the American people for these acts of technological murder, the fiftieth anniversary of the atomic bombings provide a good opportunity to do so. The President would grow in stature and become a true statesman, and it would have a real psychological effect on nuclear disarmament.

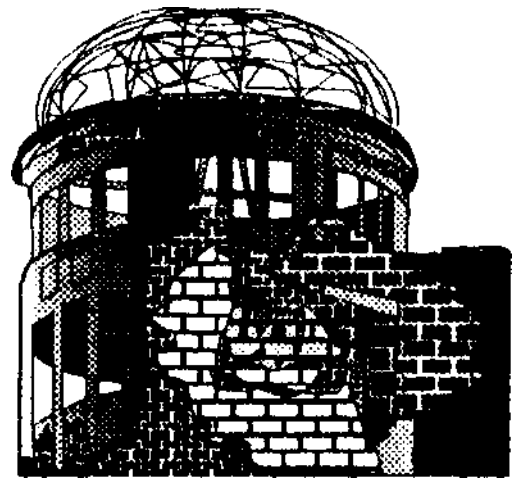
Bill Witherup
from The Bulletin of Atomic Scientists

My parents and two older sisters were in Hiroshima's Minami-machi area, two kilometres from the epicentre, when the atomic bomb was dropped. My eldest sister was three years old, and the next was born in February of the following year, which meant she as exposed while in the womb. My mother's parents, who lived about a kilometre away, died instantly amidst the roaring conflagration. I was born in 1949, four years after the bombing, and another four years after that, in 1953, my father died.

Although my mother had burn scars from her back up to her shoulders, she raised the three of us alone and in her weakened condition. She's now 83 years old A few years ago she broke a bone and is now confined to a wheelchair. Her life alternates between a senior citizens' home and my home.

So, I am a second generation Hibakusha. The hibakusha's perspective on today's society is coloured by their hellish experience. Just as it colours my father's death and my mother's life for me. I sometimes wonder that if the bomb hadn't been dropped maybe my father would still be alive, and my mother would have been spared so much suffering. Now that I am a father myself, I am not completely free of fear for the health of my own children, who are third-generation hibakusha.

Hiroshima has always been a good argument against the atomic bomb. But although the Cold War has supposedly come to an end, there are still many nuclear weapons throughout the world Due to nuclear weapons' testing and accidents in nuclear facilities, many people have become hibakusha.



A look at the area around Hiroshima shows that we're surrounded by war preparations. There is the US military base at Iwakuni, the Self-Defence Force bases at Kure and Kaita, US military ammunition dumps in several places and more. How can Hiroshima be the fountain-head of world-wide peace campaigning surrounded as it is by all these military installations? Living here in Hiroshima, I have seen its reconstruction and growth into a huge city, but it worries me that the Gembaku Dome now looks smaller both literally and figuratively.

The major challenge to the children of atomic bomb victims is how to use the Hiroshima experience to counter any repetition of past mistakes. This year I would be sitting down with my mother and listening carefully to my mother's stories of that time. It will be a source of spiritual energy that will guide me the rest of my life.

Shqji Kihara
NUKE-INFO Tokyo

I wasn't even born when the atom bombs were dropped fifty years ago. And yet I too have some thoughts to share since in a strange way my birth is linked to Hiroshima.

My father was a doctor of medicine specialising in radiology, who joined the British Indian Army since his private practice wasn't working too well. Within six months he was sent to Singapore where he became a prisoner of war of the Japanese at the fall of Singapore in August 1942. My mother had no news of him for more than three years. As prisoner of war, my father wasn't treated any worse than others. In fact being a doctor, he wasn't required to do the hard manual labour on the trans-Malaya railway, which proved a graveyard for many of his colleagues. Yet, by the time he returned after the Japanese surrender following Hiroshima, he was, I am told, just bare skin and bones having lost twenty kilogrammes in weight and had forgotten names of even his children. Under my mother's loving care, however, he recovered and then went on to do pioneering work in establishing radiology in India.

I believe that my parents had decided to have no more children long before I was born, but their delight in having survived the war made them change their minds. Would my father have survived without the atomic bombing of Hiroshima and Nagasaki? One never can tell about survival, but I personally doubt it

In September 1981, we were returning to India after a two years stay in the United States and took a short holiday in Japan and went to see Hiroshima. Today, Hiroshima is a modern city—a symbol of resurgent Japan. But underneath the surface there are scars of the misery the Bomb continues to inflict. Not even my father's life and my very existence I feel are worth that suffering.

Surendra Gadekar

French High-handedness on the High Seas

George Orwell points out a strange fact regarding behaviour of colonial masters. The violence needed to maintain the relationship of oppression ate away their own innards like a cancer so that the sufferers of colonial oppression were not only the colonised but also the colonisers. The recent 'troubles' in France reminded me anew the truth of this observation. Would the French state of Jacques Chirac behave in such a high-handed manner at home if it was not indulging in the same behaviour in Polynesia?

On July 10, ten years to the day after France bombed the *Rainbow Warrior* and killed photographer Fernando Pereira, some 150 French commandoes gave a repeat performance, surrounding and storming the ship as it sailed into the nuclear test exclusion zone. Tear gas canisters were thrown on board; doors and windows were smashed.

The raid happened just as the new *Rainbow Warrior* had entered the 12 mile exclusion zone around Mururoa nuclear test site at 5.00 A.M. local time, attempting to delay preparations for the French nuclear test. The *Rainbow Warrior* was rammed by a large tug, causing damage to its bow, before being towed to a mooring point inside the lagoon. Three out of four Greenpeace inflatables—launched outside the 12 mile exclusion zone at 2 A.M. and 3.30 AM local time succeeded in entering the lagoon and reaching the drilling rig, belying French claims that they had sufficient resources to repel Greenpeace. Two activists scaled the rig and occupied it for more than 20 minutes. The inflatables were then boarded by commandos after a two hour chase through the lagoon.

The 23 crew from both the inflatablcs and the *Rainbow Warrior* were transferred to Mururoa and held and interrogated by military police for more than 15 hours. Crew identified themselves as "Fernando Pereira".

"The best commemoration of Fernando's death we could offer was our action today" said Mills, one of the crew. "An end to nuclear testing now and forever is what Fernando would have wanted us to fight for."

International Piracy

At 7.30 AM, on October 25,1995 the *Altair* (59 meters long, 859 tons) entered the Mediterranean port of Brindisi along with four inflatablcs to block the French destroyer, *Dupleix* (139 meters, 4300 tons), which is armed with Exocet missiles.

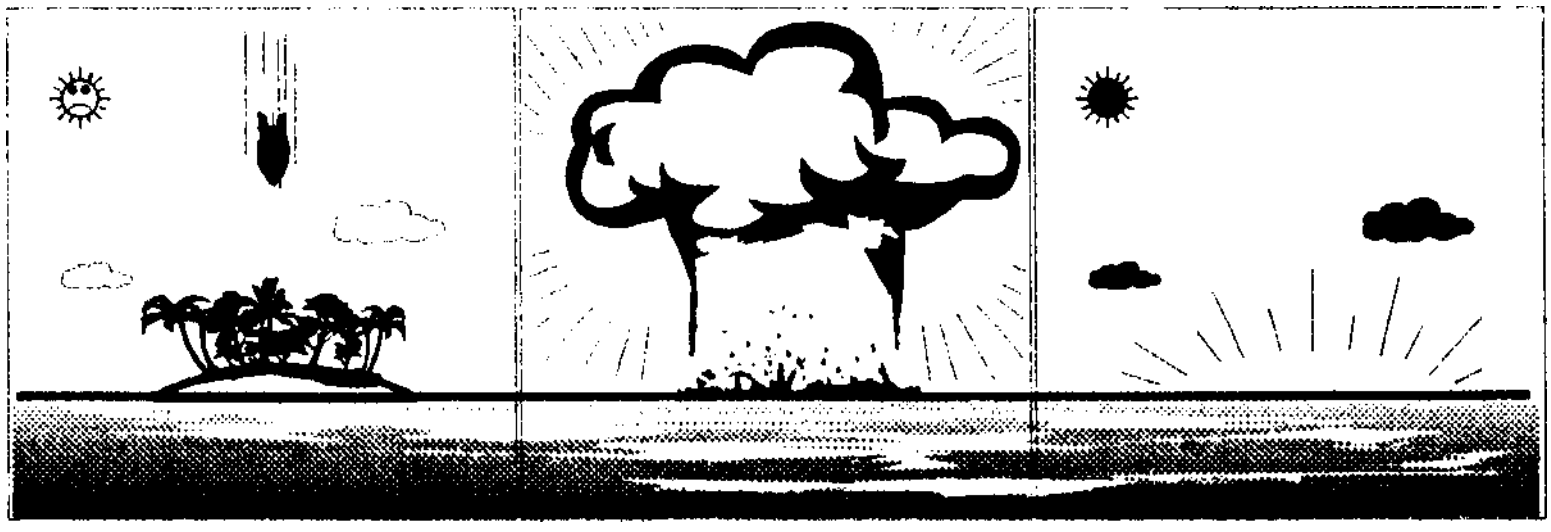
The *Altair* sent its inflatable with activists on board, who painted on the sides of the destroyer "Stop Nuclear Tests". In the meantime, four other activists chained themselves along the dock to the mooring ropes of the *Dupleix.* The crew of the *Dupleix* immediately shot at the inflatablcs with water cannon and started flooding the *Altair's* engine room.

At 8.40 AM, French Navy Soldiers armed with axes stormed the *Altair,* damaged the rudder and broke on the portholes. They threw tear gas into the engine room and forced the captain and crew members of *the Altair* to leave the ship. Having taken command of the *Altair,* the soldiers started the engines, put the gears into reverse and abandoned the vessel, which went full speed backwards into the harbour. The *Altair* nearly collided with other vessels (a speed boat of the Italian Financial Police and two Coast Guard speedboats) and then crashed several times against the dock. The fire brigade of Brindisi harbour intervened and managed to turn off the engine.

During the assault, *one Altair* crew member was injured and lost two teeth. "Greenpeace continues to work world-wide as a catalyst of international public opinion with peaceful demonstrative actions whenever possible to stop nuclear testing," said Captain Enever.

"The French assault is an act of international piracy," said Giusseppe Onufio, nuclear campaign spokesmen of Greenpeace Italy.

Terrain August & November 1995



Decolonisation: French Style

Mysterious Army Activity at Pokharan

Some curious developments have been taking place since November at Pokharan. The site has been fenced off. Boards declaring the area out of bounds have sprung up. Across the fence, there are even signs to suggest that earth movers have been used for excavation work on the site. And though the government has emphatically denied repeated US assertions that it is planning to conduct another nuclear test at Pokharan, nobody has any explanations to offer.

Three kilometres ahead of Loharki village, which in turn is some 34 km from Pokharan and adjacent to the nuclear-testing range, a dusty sand trail breaks off from the main road to lead to the nuclear site where the country conducted its first test on May 18,1974.

Six kilometres on foot into the desert, and over sand dunes, is the latest site, identified by a huge earth mound and shale rocks surrounding a crater. Twelve-feet-high concrete pillars support the barbed wire which fences of the site. The entire test site is surrounded by these pillars. A sign, freshly painted in red, prohibits entry into the area. An Army camp, a few kilometres behind the site, ensures people stay away from what could easily described as the most sensitive patch of barren land on the map of the country.

Villagers of Loharki say the site was fenced recently and people were told not to venture near it. On close examination one the detect fresh bulldozer tracks, used for removing earth. One can also spot cement though no one has a clear idea of what use was it in the test site.

Villagers are puzzled why the government suddenly decide to fence off the test site in Range A, not used for anything after the 1974 test. Range A, demarcated by white pillars, located 200m apart, is spread over a huge expanse of undulating arid flatland pockmarked with sand dunes.

Another new edition to the landscape near the test site is a huge sand dune —the locals refer to it as a ti*bba* — which was not natural creation Those allowed entry into the test range to collect shell scrap say they have not come across the signs of any fresh tunnelling activity. Yet they say the tibba is unnatural, suggesting that only some recent excavation work could have created this.

The massive Pokharan testing range complex is divided into four ranges. While Range A is to be used exclusively for nuclear tests, ranges B and C are used by the Army for weapons trials and desert exercises. Range D is used by the Indian Air Force.

Those living in Hagi Bali Mohammed village, just outside the nuclear test range, say there was intense Army activity in and around Loharki village in November and the entire area was fenced to ward of outsiders.

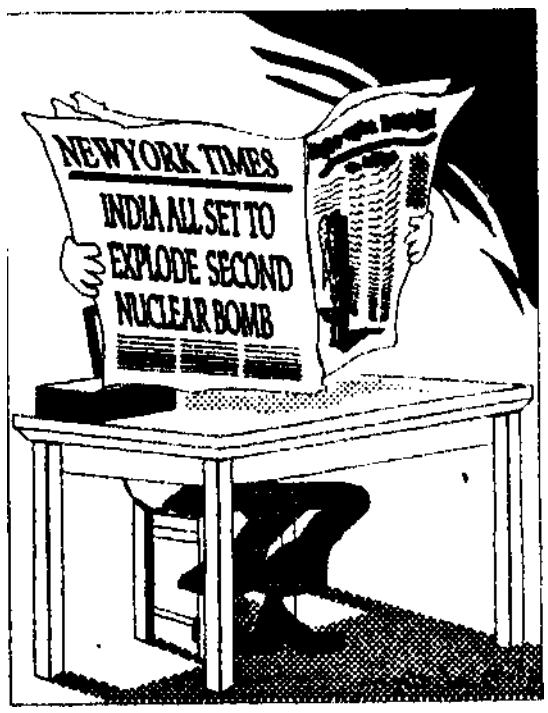
"We are even not allowed to enter into our farms ... this kind of large Army deployment has not been witnessed by the villagers near Range A as far as we can remember," says Bhanwar Singh, former sarpanch of the Loharki village.

While there always has been routine firing of live ammunition and exercises in sectors B, C. and D by the Army and the Air Force, this is the first time in many years that top defence officials and a large Army presence have been seen inside Range A. Villagers such as Malka, just opposite the nuclear site, Kalan, Nautala, Etah, Palana, Hoparadi, and Tadama were abandoned as they were inside the test Range. Though reports of Loharki being abandoned appeared at that time, old-timers in the village denied they had been moved out-
Range A today is just a sea of sand and the top brass and defence personnel teeming in the area only a month ago have all gone. While firing and test exercises and being conducted on ranges B and C, the command posts set up in and around Loharki have long been dismantled. Dust winds have covered the area which had been used as a temporary helipad for the top brass.

Although the Americans have been maintaining that spy satellites picked up signs of cables being laid, villagers say the only activity they saw was the installation of a six-kilometres-long water pipeline leading to their village. But even this pipeline has since been removed by the Army.

When the correspondent tried to check with the Army officials, they simply said, " Nobody will answer these questions." Nor is anyone posted locally to provide answers to sensitive questions.

Shishir Gupta
Indian Express



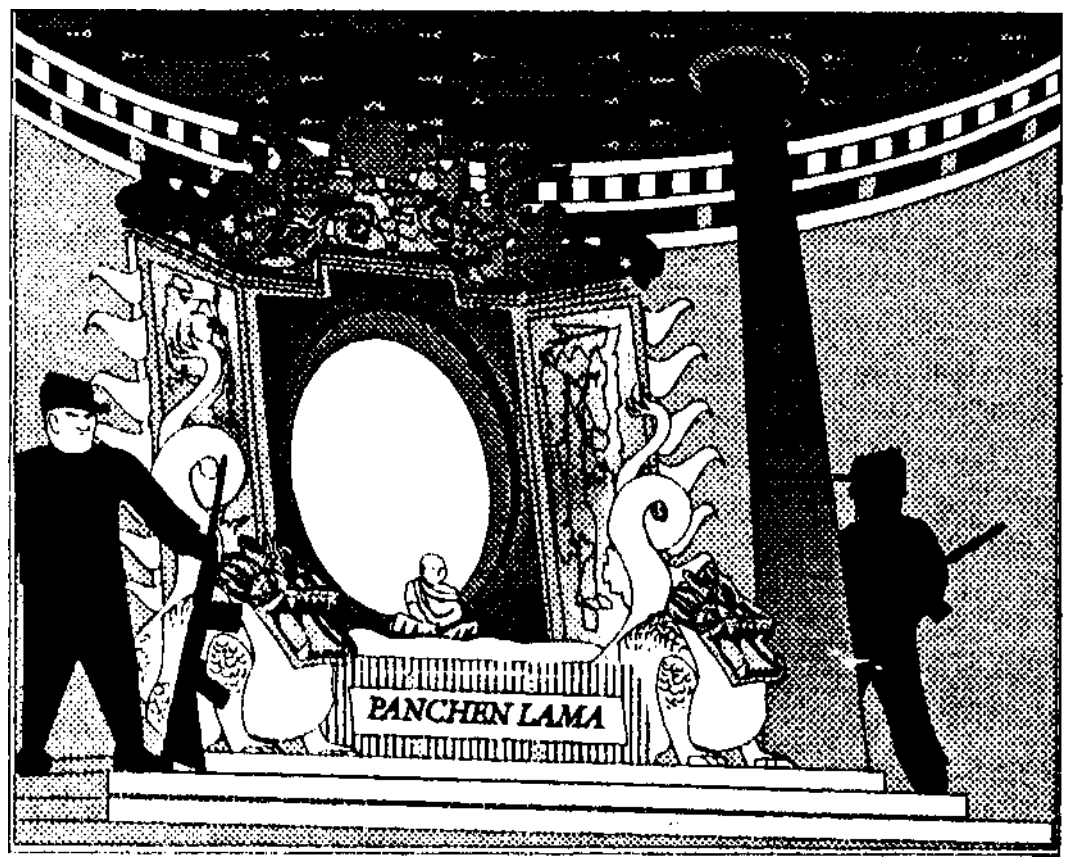
Recolonisation:
American Style

China's Broken Hearts

At one level, there is greater political tolerance in India than in China. And yet, par~~adoxically~~, Indian intellectuals especially scientists, are more timid in speaking out their minds and trying to influence public policy. Even an outright stupidity like the grant of Rs. 750 crores for fusion research has not drawn any sustained public criticism. This massive wastage of research funds is going to ultimately hurt them (scientists and researchers) the most. Hopefully, the following article will strengthen the backbone.

Ever since the massacre at Tiananmen Square six years ago, the scene that I saw with my own eyes has haunted me. On the morning of June 4, 1989, the blood of students was everywhere on the streets, and the name lists of hundreds of dead and wounded were hung on the gates of hospitals in Beijing. The deep wound in the hearts of the Chinese people will never be healed if the current Chinese Government verdict on it is not overturned.

Every year since 1989, as the anniversary of the massacre approaches, a few brave people petition the Chinese government to re-evaluate its verdict. On May 15, 1995 45 intellectuals asked the government in writing to stop regarding people of independent thought as "hostile elements." More broadly, the petition addressed to President Jiang Zemin and Qiao Shi, Chairman of the National People's Congress, asked the government to practice more tolerance toward dissidents.



Decolonisation: Chinese

Most of the petitioners are prominent old scientists, very senior and influential. They include, Wang Ganchang, 88, one of China's best known physicist and a key member of the team that developed China's first atom bomb, tested in 1964.

The petition called upon the Chinese government to live up to a U. N. resolution that proclaimed 1995 as "The United Nations Year of Tolerance." It noted that China was a founding member of the United Nations and it holds a permanent seat in the security council. "China should conscientiously implement this resolution, so that this spirit of tolerance, a spirit with which our country is relatively unfamiliar, may take root and flourish in areas like our country's politics, thought, religion, culture and education."

The petition calls for a revaluation of the June 4,1989, incident and the release of those people who remain in jail. Governmental leaders surely know that the longer the revaluation is postponed, the harder it will be for the wounds in the hearts of the Chinese people to heal and the more bitter will be their feelings toward the government.

The May 15 petition is not likely to change the attitude of the Chinese government toward the Tiananmen tragedy. On the contrary, they have detained some leading dissidents, put many of the petitioners under virtual house arrest, and they have continued to harass those who publicly voice their ideological differences.

As they punish outspoken dissidents, the Chinese government says that protests threaten social stability. But history suggests that when repression overrides tolerance, there will never be lasting social stability. Repression can maintain surface stability for many years but never forever. Social stability can be realised only by adhering to the rule of law, permitting freedom of speech and by tolerating different political views and diverse ideologies. The current leaders are stubbornly blind to the fact that if the government fails to take the lead in reversing the official

Square, the
force them to do so.

China is heading toward a democratic future. No one and nothing can stop that

Lee Zbee
The Bulletin of Atomic Scientists
July/August 1995

verdict on Tiananmen
people will someday

Hidden Killers

The Landmine Scandal

One of the most dreadful pictures that I have recently seen was of a little boy covered in blood. The stump of one leg poked out from the rags covering him. He was the victim of an Afghan landmine and could not have been more than six or seven years old.

There could be many such pictures, for it is often the children who suffer. World-wide, landmines kill 800 people every month and mutilate many more. Since there are about 100 million unexploded mines in place in over 60 different countries, and another 100 million stockpiled, they will continue to mutilate and maim for many years to come. UNICEF estimates that for every 20 of the world's children, there is one active landmine. They have become the cheap portable weapons of terror, with civilians often the chosen target. Some are planted by ground troops; some scattered by artillery shells; and many, as in Laos, dropped randomly from planes.

Today these mines are tiny instruments of calculated cruelty. The M-14 American anti-personnel mine measures only 4 x 5.5 centimetres and is almost impossible to detect visually. The Italian Valmara bounding mine 69 is a vile device which is hurled several feet up in the air before it explodes, firing hundreds of ball bearings or steel tubes out to a range of 30 metres. A new horror is the use of plastic shrapnel makes it undetectable by X-ray if any victim can get near an X-ray machine.

Oxfam has called them "weapons of mass destruction in slow motion." In Cambodia, where every citizen in 236 has had a limb amputed—compared to one in 22,000 in United States—landmines caused half the casualties in the twelve year civil war.

Today there arc 19 million refugees in the world who have fled from their countries as a result of armed conflict and another 25 million displaced people. Landmines are undoubtedly the biggest impediment to refugees going home, because of the high risk in areas of recent conflict. Poor farmers in places like Cambodia or Mozambique have two options: take the risk of ploughing a field and be killed or have an arm or leg blown off, or stay out of the field and go hungry.

Where do these mines come from? Not from the countries where they cause destruction. Between 1970 and 1992, according to Pax Christi, 28 companies in Austria, Belgium,

Britain, France, Germany, Greece, Italy, Portugal, Sweden, Spain and Turkey produced several million landmines.

There are, however, substantial signs of hope. A one year moratorium on landmine export declared by the United States in 1992 has been extended. President Clinton has written to over 40 countries which produce landmines asking them to halt exporting for three to five years. In November 1993 the General Assembly of the United Nations called for a global moratorium on exports for three years. This proposal received an affirmative British vote but with an explanation which effectively emasculated it: "Anti-personnel mines directed at military targets are a legitimate form of self-defence...If self destructing or self neutralising, they do not pose grave dangers to civilian populations." It is generally agreed, however, that the failure rate even with self-neutralising systems is at least ten percent, and could be much higher.

The coalitions opposing

The Convention to Outlaw Landmines Self-Destructs

The Inhumane Weapons Convention Review was held in Vienna. After three weeks of discussion it ended in a stand-off. At the beginning of the review conference, amputees presented the delegates with 1.7 million signatures from people in 53 countries calling for a complete and total ban. Yet the delegates did not concent themselves with the humanitarian cost of 100 million landmines contaminating 64 countries around the world. They were more interested in finding exemptions for their mine systems.

States from the South especially India, Pakistan and China would not accept the Western technological solution of self-destructing and self-deactivating mines which would inevitably cost a great deal more than "conventional" mines. The Western block in turn would not agree to inexpensive transfer of technology needed to manufacture such "smart" mines. And nobody agreed to a simple suggestion of holding the next review meeting in a mine infested territory to gain first-hand experience.

In the three weeks while delegates talked and discussed, more than 1600 people around the world were killed or maimed by landmines.

greatly strengthened treaty which would ban production as well as export, cover the civil wars which arc almost the norm today, and oblige suppliers and users to fund major clearance and recovery programmes. Granted the increasing disgust at the continuing slaughter of civilians, some of those aims may well be achieved

Meanwhile, support is needed for one very effective non-governmental mine clearance operation. The Mines Advisory Group was founded by Rac McGrath, who served as a soldier in the British Army for 17 years. His experience in clearing mines in Afghanistan for the United Nations in 1988 led him to found this remarkable charity in 1990. The group now has a team of over 600 workers clearing mines in Kurdistan, Cambodia, Laos, and Angola. Most of those trained for this dangerous work are natives of the countries concerned. One worker has been killed by a mine and another in northern Iraq murdered But in the five years since it was founded, the group has succeeded in removing thousands of mines.

Such humanitarian work is beyond praise. But alongside it must go the effort to build the structure of a genuine global community. Just-war theorists and promoters of non-violence can on this issue unite in efforts to make war and its ghastly consequences at least less likely.

Bruce Kent
The Catholic Radical
Dec 1995/January 1996

Are Atomic Bombs Legal?

The International Court of Justice About to Give Its Verdict

Fifty years after atomic bombs devastated Hiroshima and Nagasaki, the International Court of Justice, is preparing to make a landmark, though non-binding, pronouncement on the legality of nuclear weapons, as the United Nations' main judicial body, the court has been asked by the World Health Organisation and the U. N. General Assembly to deliver an advisory opinion on the issue.

This is supported by the World Court Project, which is an international alliance of citizens' groups. It was founded in 1992 with the aim of bringing the legality of nuclear weapons before the International Court of Justice at The Hague. The co-founding organisations are the International Peace Bureau (IPB), the International Association of Lawyers Against Nuclear Arms (IALANA) and International Physicians for the Prevention of Nuclear War (IPPNW).

The court is now considering whether the use or threat of use of nuclear weapons is permitted under international law. It is expected to make its ruling early in 1996.

Peter Weiss, one of the lawyers working for the World Court Project, believes that nothing but good can come out of this historic hear-

in "If a majority of the court says that nuclear weapons are legal, there will be a tremendous push to get a convention outlawing them like the treaties abolishing biological and chemical weapons. If a majority says that they are totally illegal, that will give a strong impetus to the movement to implement the court's decision.

The World Court Project believes that clarification of the law by the International Court of Justice is a vital step towards the global abolition of nuclear weapons.

43 states, a record number, have made written submissions to the World Court on the question of whether the threat or use of nuclear weapons violates international law. Oral proceedings were held from 30 October, to 15 November, 1995 which were open to the public.

The advocate for World Health Organisation gave a sober and detailed account of the special nature of nuclear weapons, stressing their radiological effects which are impossible to contain either in space or time.

France argued that nuclear weapons are not fundamentally different from other weapons. When the use of armed force is legal, there ought not to be any prohibition on nuclear weapons. Germany and Italy, both members of the NATO nuclear alliance, supported nuclear legality, arguing that disarmament negotiations might be endangered by a Court ruling. Since the only negotiations underway concern the Comprehensive Test Ban Treaty and control of fissile materials, it is difficult to see how this argument applies.

Russia followed the line of other nuclear weapons state, arguing that there are no specific treaties on nuclear weapons and that humanitarian law does not apply in this case.

However, Egypt, Mexico, Iran, Indonesia, The Solomon Islands, Samoa, Australia, New Zealand, San Marino, The Marshall Islands, Qatar, Malaysia, Costa Rica, The Philippines and Zimbabwe produced strong antinuclear arguments, presented with great coherence. Mexico and Iran warned of their potential withdrawal from Nuclear Non-proliferation Treaty should the nuclear weapons states fail to fulfil their disarmament objections. Malaysiacalled on the court to reject the nuclear domination of the big five and rule in favour of the vast majority of countries supporting the illegality of nuclear weapons. Australia, in a stunning reversal of its previous support to US nuclear policy, argued that self-defence is not a justification for genocide or for indiscriminate attacks on the civilian population. Foreign minister, Gareth Evans concluded that "it is illegal not only to use or threaten to use nuclear weapons, but to acquire, develop, test or possess them." In a direct challenge to the nuclear weapons states he declared that they must "within a reasonable period of time, take systematic action to eliminate completely all nuclear weapons.

Japan, in spite of heavy US pressure, argued that nuclear weapons are clearly contrary to the spirit of humanity that gives international law its philosophical foundation, but stopped short of concluding that the weapons are illegal. The ambassador then presented the mayors of Hiroshima and Nagasaki emphasising that their testimony was independent of the government's view. The mayors reminded the court the mind-numbing damage these weapons brought to their cities.

Co-ordinating their presentations, Samoa, and the Marshall and Solomon Islands, expressed their outrage at nuclear testing and the suffering it had caused.

On the final day, UK and USA insisted that the court should refuse to give a ruling. United States defended nuclear deterrence by claiming that it had preserved peace for the last fifty years and the UK said that calling it into question would be profoundly destabilising. Both states argued that since the nuclear states have built up large arsenals and no treaty specifically prohibits nuclear weapons, the court cannot rely on an international consensus of illegality.

Besides the government presentations, the court received over 3 million declarations, which citizens all over the world had sent in against nuclear weapons.

Colin Archer
WISE News Communiqui 443

The Cold War's Continuing Casualties

Since the Manhattan Project, the United States has spent more than $4 trillion and employed more than 500,000 workers to develop and produce nuclear weapons. As nuclear weapons production workers confront thousands of layoffs, they are concerned that occupation-related health problems are a low priority for the government

The preliminary results of health assessments of nuclear weapons production workers conducted by Elizabeth Averill Samaras for the Alice Hamilton College of the Oil, Chemical and Atomic Workers International Union (OCAW) reveal worker concerns about future health problems, inadequate health insurance and high levels of exposure to

substances such as ionising radiation, beryllium, asbestos and carbon tetrachloride.

The US Department of Energy (DOE) is spending $6.5' billion every year "remediating" sites contaminated with nuclear waste. Ironically the department is not spending anything on remedial activities for workers who have been contaminated. These nuclear veterans have a statutory entitlement to medical surveillance and exams that have never been funded.

Beryllium Boom and Bust

In the mid-1950s, the Atomic Energy Commission awarded the Beryllium Corporation of America a five year $23 million contract to produce 500,000 tonnes of beryllium — a strong but malleable metal used extensively in nuclear, electronics and aerospace industries. Beryllium Corporation came to Hazelton, Pennsylvania in 1957 and brought with it a welcome economic stimulus and a source of steady employment. More than 1200 people worked in the factory till it closed down in 1980 and refined thousands of tonnes of beryllium ore into metal. But now, almost 40 years later, all that remains of the enterprise is a legacy of occupational disease.

At the time the Hazelton beryllium plant was designed, scientists already knew about the dangers posed by exposure to beryllium dust. Workers confronting high exposure levels commonly develop acute symptoms similar to bronchitis or pneumonia. Lower exposure levels can cause chronic beryllium disease (CBD) — characterised by lung inflammation and scarring — including granuloma, the growth of tumour like masses of capillaries on the lung surface. CBD can sometime take several decades to develop. When it does show up, it can become a seriously disabling disease with such symptoms as shortness of breath, coughing, chest pain, fatigue, loss of appetite and weight Most CBD victims are able to control these symptoms with drugs , though the disease can be fatal without early detection and treatment

Air quality standards for beryllium dust were set by the Atomic Energy Commission in 1950, seven years before the beryllium plant came to Hazelton. In 1993, a local newspaper, Wilkes-Barre Times Leader, uncovered AEC documents that revealed that a 1958 air sample taken at the Hazelton plant found beryllium dust levels that were 330 times the maximum allowed. Air samples were taken at the plant at least twice a year. These samples exceeded the regulatory standard in 15 reports uncovered by the Times-Leader though the company had installed new air filtration equipment in 1958.

AEC's exit

After the expiry of Hazelton Plant's government contract in 1962, the company's chief customers became private industries. As a result, regulatory responsibility for the health and safety of the plant workers shifted from the ABC to the Pennsylvania state Department of Health. In the mid-1960s, the Hazelton beryllium plant was bought by Kawecki-Beryl-co., which sold the plant to the Cabot Corporation in 1978.

In 1970, the workers at the plant unionised with the Oil, Chemical and Atomic Workers International Union (OCAW). Company doctors told workers — many of whom had previously worked in coal mines — that the symptoms they were describing were 'miner's asthma.' Upon learning from the workers about conditions inside the plant, the OCAW brought in doctors and an industrial hygienist. Independent medical consultations led to the diagnosis seven cases of beryllium disease amongst employees who had already been cleared by company doctors.

OCAW also fought to obtain records of air sampling conducted by the Pennsylvania Department of Health. Some of these records were eventually released indicating high levels of exposure to beryllium dust at the Hazelton plant

Beryllium reaper

Former workers and their families blame more than 90 deaths on the elevated beryllium levels. Jim Leonard, son of a former worker and an advocate for their cause contacted the OCAW in 1992, in response to the rising number of illnesses amongst former plant workers. Leonard's father, Albert, worked at the plant from 1960 to 1973. "Almost from the beginning of his employment my father was sick," says Leonard. "It started with skin rashes. Then he developed a cough. As he was coughing, a clear liquid would come out of his lungs. He just never felt right or normal after that" Albert Leonard died from beryllium disease in 1986 at age 58.

Premature deaths of workers could and should have been prevented since the government and the doctors knew about the hazards of beryllium exposure. After exposure, early detection and intervention — which can often control the symptoms of the disease — is vital to the lives of remaining workers. Medical screening — which costs $300 per worker— can help monitor the symptoms of the disease. Once detected, treatment can begin.

Amongst former Hazelton plant employees facing increased risk of beryllium exposure disease, nearly 1200 are still alive. Because beryllium disease can take 20 years to surface, workers often experience the health consequences of their jobs long after Pennsylvania's six-year statute of limitations on worker's compensation runs out

Lawsuits to get medical help to workers have failed. The courts have

ruled that workers cannot prove that their employers intentionally injured them. The corporations have argued that, once excessive exposure levels were detected, workers were issued respirators. Plant management also took yearly chest X-rays to detect beryllium disease and installed safety equipment in 1970s.

Although the courts have ruled that Cabot Corporation has no legal responsibility for the health of former workers, it has also held the plant responsible for environmental damage and ordered the corporation to spend $4 million to clean up the site. "Millions of dollars will be spent to cover or bury the shit left over, yet they won't spend a few thousand on the workers," a former worker said at a meeting organised by OCAW.

Reluctant DOE

Denied medical assistance by the owners of the beryllium plant and state workers' compensation programme, former Hazelton workers sought DOE relief. Given that the beryllium processed at Hazelton supplied US nuclear weapons fabrication facility at Rocky Flats and Oakridge, and also the fact that there already exists health monitoring of past and present workers at both these facilities, The workers' union appealed to energy secretary Hazel O'Leary to include them in this government programme as well. After an eight month delay, there appeal was turned down on the ground that "there is no apparent legislative authority." However, after intense lobbying by supporters including, members of the House of Representatives, DOE has indicated that an award of $400,000 will soon be announced to fund a programme of beryllium medical research and surveillance. The award is expected to include medical screening of at least some former Hazelton workers.

Katherins Issac
Multinational Monitor October 1995

Potatoes Were Guarded Better

On November 27,1993, at about 1.00 a.m., Capt. Alexei Tikhomirov slipped through an unprotected gate and into the Sevmorput shipyard near Murmansk—one of the Russian Navy's main storage facilities for nuclear fuel. The 35 year-old deputy chief engineer then climbed through one of the main holes in the fence surrounding the "Fuel Storage Area 3-30", sawed through a padlock on the back door, and pried open the door with a metal pole he found next to the building. Once inside, Tikhomirov located the containers of fresh submarine fuel, lifted the lid off container No. 23, and broke off parts of three assemblies for a VM-4-AM reactor core. Stuffing the pieces (containing 4.5 kilograms of enriched uranium) into a bag, he retraced his steps.

Outside the shipyard he was met by an accomplice, former naval officer Oleg Baranov. Baranov dropped Tikhomirov off at his home, and then drove to the nearby town of Polyarny, where he hid the nuclear material in his garage.

The third man behind this operation was Dmitry Tikhomirov, Alexei's younger brother, who at the time of the theft was chief of the refuelling division at the shipyard. He had briefed his brother about security at the site, the holes in the fence, and the design of the fuel assembly.

None of the conspirators had a prior criminal record. They also lacked contacts for selling the stolen material, for which they hoped to receive $50,000. According to the official record of the investigation, they waited six months before they began to search for customers. But when Dmitry Tikhomirov told a fellow officer about the theft and asked for help in selling the stolen merchandise, the conversation was reported to authorities. In late June 1994, the three conspirators were ar-

Tempting Targets

Enriched uranium is the standard fuel for propulsion reactors used in both Russian submarines and surface ships. The level of enrichment varies depending upon the type of vessel from 20 per cent to weapon's grade (90 per cent). Soviet Union built over 250 nuclear power vessels. Most of these vessels have two pressurised water reactors which, under normal operating conditions require refuelling every seven to ten years. The cores of these reactors hold typically between 200 to 300 fuel assemblies, each containing several fuel rods. If this fuel has been enriched to 90 percent or higher, about 10 fuel assemblies could supply enough uranium for a bomb.

Huge stocks of fresh fuel are stored in five main storage sites. Shipyard No. 35 at Sevmorput near Murmansk, the "Sevmash" Shipbuilding Plant at Severodvinsk, the naval base at Zapadnaya Litsa west of Murmansk, and two "technical repair bases" near the Gomyak Shipyard at Krashennikova

rested and the stolen goods recovered.

The theft itself was discovered only 12 hours after it occurred.. Carelessly, Alexei Tikhomirov had left the back door of the storage building open. Two guards on patrol noticed the discarded padlock and the broken door seal, and a prompt search revealed the broken fuel assemblies.

Holes in the fance

According to Mikhail Kulik, the special investigator for the Northern Fleet Military Procuracy—and the chief investigator of the Sevmorput diversion—potatoes were guarded better than radioactive materials at the time of the theft at Murmansk. "On the side of the shipyard facing the Kola Bay, there is no fence at all. You could take a dinghy, sail right in—especially at night—and do whatever you wanted. On the side facing the Murmansk industrial zone there are holes in the fences everywhere. And even in those places where there aren't any holes, any child could knock over the half-rotten wooden fence boards."

Kulik reports that some security improvements were made after the discovery of the theft. The number of guards were increased and they were issued walkie-talkie sets. Planks were nailed to cover some of the holes in the fence. More sophisticated security systems, although proposed were not put in place because of cost. Reportedly, there still are no surveillance cameras around the perimeter, and the integrity of the fuel containers is checked by sight only. According to Kulik, the first and last time the contents of most of the containers was checked was at the fuel-fabrication plant. He believes the diversion at Sevmorput "could have been concealed for 10 years or longer," had the open door of the storage building not attracted the guards' attention.

The case highlights the difficulty of guarding against the "insider threat", which is the greatest security danger, according to Russian nuclear safeguards officials. The current crises in Russia has eroded human reliability. A combination of factors—the end of Cold War, the accident at Chernobyl, the contraction of Russian defence and nuclear sectors, and the inability of the state to subsidise previously privileged workers in the nuclear industry and the military—has resulted in tremendous economic and social upheaval. Moral standards have eroded. As a result the primary threat to nuclear safeguards in Russia today is a knowledgeable and corrupt insider (or group of insiders) who have access to nuclear materials and may attempt to steal them for profit, for political reasons, or because they are coerced by a criminal organisation.

At the time of this writing, Alexei and Dmitry Tikhomirov and Oleg Baranov were standing trial in Murmansk for their involvement in the theft of naval reactor fuel from the Sevmorput shipyard. The hole in the fence that Alexci climbed through to gain entry to the storage facility is said to be patched shut. But the underlying gaps in the Russian safeguards system remain.

Edited from an article by Oleg Bukharin and William Potter in Bulletin of Atomic Scientists May/June 1995

Book Review

With Hiroshima Eyes : Atomic War, Nuclear Extortion and Moral Imagination

Joseph Gerson

New Society Publishers, 4527 Springfield Ave. Philadelphia PA 19143 USA

First a few quotes to set the scene.

"When you have to deal with a beast, you have to treat him as a beast."

President Truman in a later to Council of Churches of Christ in America just two days after the atomic bombing of Nagasaki

"The United States dropped the bomb to end the war against Japan and thereby to stop the Russians in Asia, and to give them sober pause in eastern Europe."

William Appleman Williams in The Tragedy if American Diplomacy 1962

"The consensus among scholars is that the bomb was not needed to avoid an invasion of Japan. It is clear that alternatives to the bomb existed and that Truman and his advisers knew it."

The official historian of the US Nuclear Regulatory Commission, J Samuel Walker

"No one expected the invasion of Japan to be anything but a slaughter. Before the Japanese mainland could be secured, American casualties would amount to as many as one million men; and the Japanese were expected to sacrifice twice that number in defence of their homeland. Then on July 16, the bright glow of the Trinity test raised hopes that the war could be ended without an invasion.

American Heritage Junior library

"It is my opinion that the use of this barbarous weapon at Hiroshima and Nagasaki was of no material assistance in our war against Japan. The Japanese were almost defeated and ready to surrender In being the first to use it, we adopted an ethical standard common to the barbarians of the dark ages."

Fleet Admiral Willian D. Leahy, Chairman, Joint Chiefs of Staff for US, during the Second World War

We don't know anything about my younger brother. He was six years old. Even when people were burnt to death, you could usually find the bones and at least say, this is my house, so this must be them, but we found nothing. They must have been blown away somewhere.

Yasuko Kumura

Was Japan Always the Target?

Urgency to build the atomic bomb was most felt by scientists who bad fled Europe fearing Hitter. But was Hitter's Germany ever the target? New research suggests otherwise.

The first targeting discussion—insofar as can be determined from declassified documents and Manhattan Project histories—seems to have occurred during a meeting of the high-level Military Policy Committee on May 5,1943. According to Gen. Leslie Grove's summary of the meeting:

"The point of use of the first bomb was discussed and the general view appeared to be that its best point of use would be on a Japanese fleet concentration in the Harbour of Truk (in the Pacific, north of New Guinea). Gen. Styer suggested Tokyo but it was pointed out that the bomb should be use where, if it failed to go off, it would land in water of sufficient depth to prevent easy salvage. The Japanese were selected as they would not be so apt to secure knowledge from it as would the Germans."

"Always the Target" Arjun Makbijani

n August 6th—Hiroshima Day—Sanghamitra was giving a talk on "the implication of the Bomb for us today," at a local college. Immediately after the talk the Principal of the college got up. He was livid. "You say that the atomic bomb was not necessary to end the war! That Japan was already willing to surrender! Well, my information is different" and he proceeded to harangue the poor students regarding how the Bomb helped prevent millions of deaths in a prolonged war.

This incident is a small illustration of the pervasive effect of propaganda. Lies about the use of the bomb have been broadcast with atomic force so that today it is difficult to disentangle the truth from self-justifying myths. Considering that such is the situation in a small village in India—effectively a bystander in the conflict 50 years ago, the strong reaction amongst militarists in the US to the Smithsonian Institutions small attempt to educate the public becomes understandable. Debunking erroneous official versions of history is not an easy task.

It is for this reason, that Joseph Gerson's book "With Hiroshima Eyes" is doubly welcome. The stated aim of the book is to emphasise three points:

* Nuclear weapons have always been targeted against human beings.

  United States practice of nuclear extortion has been an essential element of the maintenance and expansion of its global sphere of influence.

  Politically engaged hibakusha are an undervalued moral and political exemplars for all people.

It is the third point mentioned above which the book brings out brilliantly. Hibakusha through their

suffering and resilience are indeed *"testimonies to the possiblities of human courage, compassion and a life-affirming future.* Fifty years after the event, the Hibakusha are slowly dying out. Soon there would be nobody with a first-hand experience of nuclear holocaust. The book brings out vividly the urgency in the statement of Masanori Ichioka, *"The hibakusha feel that they must not die until the abolition of nuclear weapons is realised"*

All US administrations since the Second World War have claimed that the nuclear arsenal was needed to maintain nuclear deterrance. This book shows that the nuclear umbrella, served an even more important function: it allowed the US unhindered access to Third World resources. However, sections of the book dealing with this role of nuclear weapons in preserving US hegemony and control are unfortunately not as well delineated. Although Gerson, gives a list of 26 incidents of nuclear extortion from 1945 to 1993, the list omits some glaring instances of nuclear extortion. For instance, the notorious 'tilt' in US policy during the Indi-Pak conflict of 1971 and the sending of the nuclear armed aircraft carrier "Enterprise" to Indian Ocean is conspicuously absent

An important point which the book fails to address deals with the feet that *all* nuclear weapons powers and even other states which believe in nuclear weapons as a currency of power, have used the concept of national "sacrifice zones" whose populations have been knowingly subjected to radioactive assaults. Native Americans of the Southwest, Pacific islanders, Australian aborigines, Algerian and Tibetan nomads, Kazhakistanis, Eskimos of the Soviet Arctic, the people around Pokhran—all are hibakushas. In fact, there is no need to fall into the artificial atoms for war atoms for peace divide. The victims of nuclear power madness run into millions all over the world.

These reservations are mere nit-picking on my part. This is a fine book which needs to be read seriously in India especially now as we too seem inclined to join the gang.

Letter (Box

A nuclear free India will not materialise out of default, nor will it evolve from knee-jerk reactions from activists hungrily awaiting to pounce on every verbal contradiction of nucleocrats—nor from uncovering reasons proving economic unviability nor the hazardous nature of of nuclear pollutants.

However sincere the efforts are, unfortunately, they are still in the realm of reactions. Historically and logically, these exercises arise AFTER the establishment acts—a dome collapses or Tarapur leaks. Perhaps activists should devote their time to energy alternatives that make ecological and economic sense.

Here, in the northern hills of Kerala, there are vast areas of lush greenery and sparkling streams. Electricity, as usual, goes to the urban centres, resulting in voltages as low as 10-15 V in Alakode! Amidst these oasis of almost pristine splendour, if a capital intensive, ecologically disastrous project were to arise, funding would flow from "tourism". And, of course, one more protest group, along with its newsletter, will be born.

Perhaps, if your journal can devote some space to realistic alternatives in energy generation, we could send you documented cases of communities attempting to solve their energy needs. In the meanwhile, we are totally with you in your devotion to a nuclear free India.

Peter Patrao The PEdal & Turbine Energy Research Trust

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Study Them To Death

" The desire for hard evidence has left victims of Chernobyl disaster limiting nearly ten years, and much inaction has hidden behind what will always remain unquantifiable".

The Secretary General of The United Nations

The International Atomic Energy Agency has a vested interest to see that radiation health damage remains forever unquantifiable, as this state of "unknowing" favours the expansion of the nuclear industries.

Dr. Rosalie Bertell

A large international conference was held in Geneva on 20-23 Nov. 1995, on the consequences of the Chernobyl nuclear accident The most important item for discussion was a report of a study by the World Health Organisation (WHO) which involved 7,000 scientists. The main result: there is a lot more research necessary. This will take several years and will cost another US $200 million. The study which started in 1992, has already cost US $ 35 million.

At the conference, the atmosphere smacked of the victims being part of a gigantic experiment.Since medical ethics forbid deliberate large Kale contamination simply for the purpose of conducting research, the attitude seemed to be, if the people are contaminated anyway, you, as a scientist have a marvellous opportunity.

For instance, scientists of the Moscow Medical Radiological Research Institute investigated the teeth of 200,000 people. By measuring the quantity of carbon dioxide in teeth, scientists ascertained the level of radiation people received. A number of scientists reported during the conference that finding out the level of radiation received was not a piece of cake. Tens of calculation models had to be drawn up, and dozens of scientists were needed to resolve the problems which arose in the course of establishing those models.

A Urge number of scientists were also needed in investigating the levels of radioactivity on 1,8 million(l) farms. A voluminous population registry was established. This contained data on four million people

whose physical condition is under observation on a regular basis.

Various organisations made contributions to the WHO research. Between 1991 and 1995, the European Commission paid about US $ 30 million for 16 projects. Often the aim of these project was the transfer of technology for radiation measurements. Almost always, the technology transfer involved the education and training of people, mainly from the Ukraine, by experts from the European Union.

The WHO project is has been going on for two years now. Too short, says WHO, to get clear results. Many Russian researchers, who consider Chernobyl as " the most tragic accident in human civilisation", say that there "was never before a chance to conduct so much research on such a large scale". They want to continue the research because of this and also because, as N. Krysenco, Belarus' deputy-Minster of health, put it," we can expect a lot more consequences from Chernobyl".

What comes through is the fact that, health problems resulting from the accident are still increasing in the Ukraine, Belarus and Russia.

The people in radiation affected areas of Ukraine are more often ill — by 30 percent — than those in other parts of the country. Illnesses of the circulatory system have increased by 43 percent, bone and muscle illnesses by 62 percent, malignant tumours by 38 percent. Surprisingly, the report shows no increase in leukaemia.

One third of the liquidators from Russia, who had to work at Chernobyl after the catastrophe, are ill and cannot work anymore; two percent of them have died. A total of 800,000 liquidators from all parts of the Soviet Union were involved in the Chernobyl cleanup.

From the Editor's

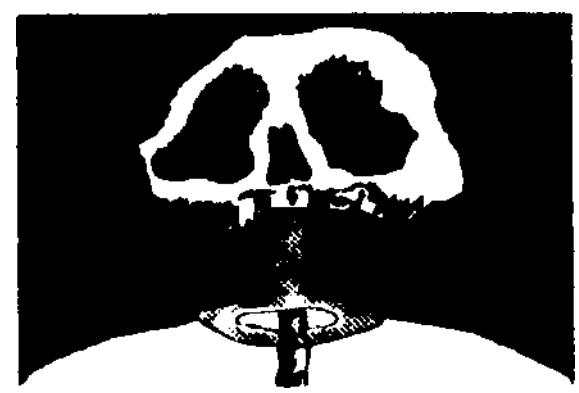
This is Anumukti's fiftieth issue. Originally we had planned to bring out something special—A history of the experience of nuclear power in India in cartoons, However, doing that properly takes time and we are already so late that we decided to bring out issues quickly and get back on schedule and then try out new time-consuming propositions.

Publication of Anumukti began on 6th August, 1987, with the statement: "Nuclear power is an idea whose bright future is already behind it." During the last nine years, the truth of this has become all the more apparent. Even nucleocrats have begun to realise the writing on the wall but the chains of private profit are stronger by far than any rudimentary cognizance of harm caused to society at large by their activities.

Normally it has been our practice not to have long articles. But we have made an exception this time since we believe the issue of radiation protection is best presented by putting up the various different arguments in all their detail. Dr. Rosalie Bertell in a speech at Hiroshima has done this in a masterly fashion. In this issue, we have articles from both Dr. Alice Stewart and Dr. Rosalie Bertell—two towering personalities whose pioneering work has done so much to elucidate the harm caused by so-called "acceptable" levels of radiation. They demonstrate the fallacies involved in the setting of standards for safe levels of radiation. It is another story altogether that even these unacceptable and unsafe international standards are still not followed in India !

On the one hand aid organisations helping the victims are finding it difficult to raise funds. It was estimated in 1991 that it would need US $ 647 million to provide effective help. The amounts raised thus far have fallen far short of this and it is becoming more and more difficult to raise new funds. In the absence of scientific proof that the health damages are indeed the result of the accident, donors say that they cannot provide money to address 'normal' health problems in the Ukraine. On the other hand, according to a senior expert of the World Health Organisation, it will take at least 20 more years before a scientific study can be conducted.

WISE News Communique 442,27 October 1995



Can Bhopal Ever Forget Chernobyl?

Bhopal was the turning point. Those eyes still haunt. But Bhopal was not merely what happened on the night of December 2 and the early morning of December 3, 1984. It is the abuse that still continues. The real disaster is the fact that corrupt people in power chose to associate with foreign peddlers of hazardous technologies and conspire against the interest and well being of theirfellow citizens.
Chernobyl is no different. Radiation community has defended its interest by denying the extent of death and suffering caused on the people involved whether they be children living in the vicinity or the 'liquidators'—a lot of whom were forced into 'volunteering' to contain the inferno.

The International Atomic Energy Agency is holding a Conference: "Once Decade after Chernobyl: Summing up of the Radiological Consequences of the Accident" in Vienna, Austria, 8-12 April 1996. Because we have watched the various attempts of the IAEA to minimise the radiological effects of Chernobyl over the past ten years, because the IAEA has a mandate from the United Nations to promote nuclear power and other nuclear technologies, and because ten years is insufficient time to allow for the development of most radiation related cancers, we believe that an independent international body, qualified to comment on the IAEA conclusions and to produce credible evidence to support its claims is a necessary international remedy for the potential damage which this IAEA Conference can cause. For these reasons we propose to hold a counter-conference in Vienna April 12-15, 1996 to undertake serious investigation of both the claims of the people most affected by the disaster, and those being attributed to the disaster by promoters of nuclear power.

The report of the Secretary General of the United Nations (Document of the General Assembly A/50/1995) specifically calls for the strengthening of international corporation and co-ordination of efforts to study, mitigate and minimise the consequences of Chernobyl disaster. In addition to the profound suffering of the people most directly affected by the disaster, there were serious violations of the human rights of the victims to understand what had happened to them and to receive assistance. There has been a remarkable imbalance in international responses to the disaster. Research activities designed to establish accurate scientific knowledge and assessment of radiation effects has often taken precedence over tangible financial and material assistance. Many nations have poured in money to map the radioactive fallout: create plans and mechanisms for possible future disasters of this nature which will take place elsewhere; develop practical means to deal with the economical consequences of contamination of food and land, and other activities basically designed to help the nucleariscd areas to the world, not the disaster victims. These international players also arc undertaking public relations damage exercise* so that people will tolerate the risks connected with further nuclear reactor proliferation.

Tribunal on the Consequences off the Chernobyl Disaster

Vienna, Austria, April 12-15,1996

The victims have not only suffered from neglect, but they have also suffered from other people's denial of the reality of their experience. Mothers, concerned about the deterioration of the health of their children were told they had "radiophobia". Persons presenting at clinics with unusual illnesses which they believed resulted from their exposure were told that there would be no radiation effects for twenty years, and perhaps then they might develop a cancer. The denial of their experience was itself painful.

This mishandling of real health problems has worked directly against the pressing health and economic survival needs of the victims. The dispute over whether or not the observed severe problems of health, especially among the children, are attributable to radiation or to other factors, has deterred many nations from helping the 400,000 displaced persons and many other severely af-

fected, survivors. All three nations close to the disaster have experienced declines in their GDP: Russian economy declined 16% in 1994 from its 1993 level; the Ukraine declined 25% over the same year; and Bylorussian economy declined by 20%. These declines follow several years of declines averaging between 14 and 17% per year. The impact of the necessity to meet the urgent medical requirements of liquidators, children, displaced persons and elderly, plus the need to redress Chernobyl's environmental and economical impacts, has devastated the shrinking economics. Belarus has had to devote 20% of its national budget expenses each year for the mitigation of Chernobyl consequences, Ukraine devotes 4% (although it maintains that it should be spending 20% at least) and Russia has maintained 1% of its national budget devoted to Chernobyl problems. The permanent contamination of much of their prime farm land further complicates the health, social and economic future of these countries. In the face of such monumental problems, trying to counteract the denials of their reality in the international circles which might have helped them had they known the truth, has become nearly impossible. It is time to bring international attention to their plight.

The secretary General of the United Nations states:

** The desire for hard evidence before action has left the victims of the Chernobyl disaster waiting nearly ten years, and mush inaction has hidden behind what will always remain unquantifiable".*

The IAEA has a vested interest to sec that radiation health damage remains forever unquantifiable, as this state of "unknowing" favours the expansion of the nuclear industries. We fear that the IAEA April 1996 meeting will further deter nations from helping the victims, and furthermore will be designed to promote nuclear technologies in the Developing Countries, assuring them that the Chernobyl problems are minor and not related to nuclear technology itself.

In response to this event, the International Medical Commission Chernobyl has been formed and has joined with the Permanent People's Tribunal to carry out the following purposes:

- 1 To provide for a fair and unbiased hearing of the concerns and evidence which have been gathered by our colleagues in Belarus, Ukraine and Russia relative to the radiological and non-radiological consequences of the Chernobyl disaster,

- 2 To provide for a fair and unbiased hearing of the concerns and evidence which has been gathered by our colleagues in Belarus, Ukraine and Russia relative to National and International responses to their needs for compassionate assistance after the disaster,

- 3 To provide for a fair and unbiased hearing of the response of our colleagues in Belarus, Ukraine and Russia to the pronouncement of the April 1996 IAEA meeting, as well as to prior documents which IAEA has released on the disaster and its consequences,

- 4 To judge the medical the medical and scientific findings at Chernobyl relative to the experience of the people of Hiroshima and Nagasaki after the dropping of the atomic bombs,

- 5 To examine the limited recognition of radiation related injuries among the atomic bomb survivors in light of the failure to recognise radiation injuries after Chernobyl

- 6 To examine the Human Rights violations of the atomic bomb survivors and the patterns of Human Rights violations observed at Chernobyl.

- 7 To provide fair, unbiased and independent judgements to the United Nations, the media, governments and concerned persons on the violations of human rights, scientific integrity and honesty which the IMCC and the PPT will be able to identify as part of the national and international response to the Chernobyl disaster.

The International Medical Commission hopes to develop an international voice for honest and just dealing with those who have already been victimised so that they are not victimised again

The International Medical Commission together with the Permanent Peoples Tribunal have been responsible for the evaluation of the aftermath of the Bhopal disaster, and have been the primary forces behind the development of International Law to provide remedies to victims of technological, industrial and medical disasters. By their distinguished panels of physicians, scientists and jurists, the IMCC and PPT hope to develop an international voice for honest and just dealing with those who have already been victimised so that they are not victimised again in the national and international responses to major disasters.

Dr. Rasalie Bertell

Tho Ruison d'etre

Why was "The Peaceful Atom" invented?

A Bomb with No Upper Limit

US military had six bombs at the end of World War II. Two were dropped on Japan, leaving four to be used in "tests" which they decided to conduct in the Pacific Islands. Testing at Bikini began in the summer of 1946, even before the United Nations had given the territory of Micronesia into the "protection" of the US as a Strategic Trust Territory. The Trust was not established until 1947, and it was only the UN ambassador from Australia who objected. The whole world knew that the US was already using the Atolls as a nuclear weapon testing range. The Australian Ambassador resigned, was replaced, and the vote taken in favour of US possession. The world looked the other way as the 32,000 people of the Marshalls were subjected to some 68 nuclear tests.

Atomic bombs had proved to be limited in size. In order to induce sustained nuclear fission, the chain reaction which produces all of the energy, the uranium 235 atoms need to be brought very close together so that the neutrons released in the splitting of one atom can reach other atoms and continue the splitting. In an explosion this fissionable material is blown apart and the reaction stops. The first hydrogen bomb explosion occurred in March of 1954 at the Bikini Atoll in the Marshall Islands. We, in North America, did not know what had happened to the Rongelap People and the other Marshallese. Nor did we really understand that this new hydrogen bomb provided the military with a bomb which had no upper limit in detonation power. The bomb was based on fusion rather than fission. In fusion, atoms are forced together rather than blown apart, and in the process they release an almost unlimited number of neutrons. The energy for fusion was produced by a fission detonation. The neutrons produced by the fusion were then absorbed into a blanket of fissionable atoms producing detonations in the megaton rather than the kiloton range.

The Peaceful Atom Programme

In the wake of the Bikini test, the military decided to change the whole arsenal to thermonuclear devices—hydrogen bombs. For this it required extensive uranium mining, a series of large production facilities to enrich the uranium, bomb production factories, and public tolerance of the waste from all parts of the cycle. They also needed the co-operation of society with the transportation of radioactive material, radioactive effluents from nuclear facilities and uranium support industries. The military needed co-operation from the universities in preparing nuclear engineers and physicists to staff its technical needs. All of this would be impossible during peacetime when the only purpose was producing weapons of mass destruction. They were already experiencing the rumbles of anger over the Nevada Nuclear Testing Site, established in 1951.

Shortly after the hydrogen bomb explosion in March of 1954, President Eisenhower made his Peaceful Atom speech in the United Nations, an people were told that this awesome energy was now tamed and could produce unlimited amounts of electrical energy. It would produce electricity too cheap to meter. It would instantly bring developing countries a modern standard of living. There would be no more war, because the whole world would have as much of the good things of life as they could ever desire. For a world just beginning to understand Hiroshima and Nagasaki, and the potential atomic megadeath, this promise of something wonderful for humanity arising out of the ashes was intoxicating. Academics, who abhorred the bomb began to study nuclear science. It became popular in schools. People became willing to mine uranium and to tolerate the effluents and waste. Nuclear engineers and physicists became like gods, and they were admired for the intelligence and their ability to attract government grants. They were superhumans, privy to secret of the gods which were totally beyond the understanding of most people. The peaceful atom myth was very successful in the public support, without which the build-up of nuclear weaponry would have been impossible. Most of the civilian enablers of this military addiction were completely unaware of their own roles. Even anti-war activists joined in.

The United Nations' response to Eisenhower's speech was to establish the International Atomic Energy Agency (IAEA). This new agency was given two mandates: to prevent the horizontal proliferation of nuclear weapons, and to promote peaceful uses of nuclear energy. It has no basic mandate to abolish nuclear weapons or to promote health and safety relative to nuclear technology. The IAEA is still busy trying to find medical, agricultural and commercial uses for nuclear energy. More recently, it has been promoting the image of nuclear power as a "safe, clean technology" by downplaying the radiological consequences of Chernobyl accident. This

doubly victimises the people who lived near the reactor: first they were innocent victims of the disaster and now their illnesses and sufferings arc being denied. I think the people of Hiroshima and Nagasaki or Bhopal can understand this injustice.

One of the physicians who served at the Bikini Atoll gave up the practice of medicine after he saw what the radiation effects were on the sailors sent into ground zero after the tests. All of the health damage was classified as secret, even from the men themselves.

Dr. Rasalie Bertell
from a talk delivered on the 50th anniversary cf Hiroshima.

Possible Fallacies in Present Cancer Risk Estimates

Dr. Alice Stewart

Exposure to radiation is an occupational hazard for those working in the nuclear industry or in medical radiotherapy; it is well-known that radiation can induce cancer in tissues. But there is a widespread belief that my monitoring radiation exposure of workers and making sure exposure never exceeds a recommended annual 50 mSv dose-related cancer risks have been kept at near zero level.

For example, a study on occupational dose and subsequent cancer risk published in 1990 by the US Committee on Biological Effects of Ionizing Radiation (BEIR) indicated that even an annual dose of 10 mSv per year for 48 years—ten times higher than the average for all badge monitored workers at the Hanford nuclear facility in the US—the risk of cancer death would still only be 23% compared with a general population risk of 20%.

As a rule, risk estimates arc derived not from occupational data but from epidemiological studies of Hiroshima and Nagasaki A-Bomb victims. Hanford became operational in 1944, time enough for some direct risk estimates to be made". However, this is deemed unnecessary since both BEIR and the International Commission for Radiological Protection (ICRP) arc of the belief that the A-Bomb data and its interpretation by the Radiation Effects Research Foundation (RERF) offer reliable risk estimates for all occasions. This consensus has now lasted for thirty years and is now so strong that only risk estimates which conform with A-Bomb data arc allowed to influence radiation safety regulations.

A-Bomb data collection and analysis left room for different conclusions to be drawn, conclusions sometimes contradictory. The original interpretation is subscribed to by the establishment, but may be flawed

Study subjects were assembled five years after the event and included those with inutero as well as post natal exposure. The then Atomic Bomb Casualty Commission — now RERF — took all survivors within a 2.5 km radius as 'cases' and the 'control' consisted of two groups, from greater distances, of the same size, age and sex composition as those cases under two kilometre.

Here then was the first mistake in data collection. By comparing matched samples which differed only in their distance from the hypocentre, ABCC failed to facilitate the easy interpretation of age at exposure related radiation effects. Given this less than perfect data base, subsequent mistakes, this time in data interpretation by RERF, exacerbate the problem.

RERF presumed an even spread of high to low doses across all ages of exposure. The evidence shows that high dose survivors were mainly young adults, suggesting some sort of survival of the fittest selective process by the high dose radiation. This theory is given added weight by the fact that the deaths before ten years of age of children of these surviving young adults was much smaller than the expected number.

RERF deduced no increase in non-cancer deaths as a result of the radiation. If the A-Bomb surviving population is compared to the controls, no significant differences arc found in the rate of non-cancer deaths. There is a presumption here of two like-for-like populations being compared. However, it may be that the non-specific effects of the A-Bomb left a highly selected population which would be less likely than normal to suffer any kind of death at a particular age. If the radiation nevertheless caused bone-marrow damage in these survivors (a cell killing effect), this would have the effect of increasing their chances of later death (deaths from aplastic anaemia—a disease arising from bone marrowdestruction—were unusually common before 1950). Thus these two opposite effects of increased and simultaneously decreased chance of survival would cancel each other out, masking a real increased risk of non cancer deaths caused by radiation.

According to RERF, although the effects of foetal radiation include brain damage, young embryos were not affected Hence, a widespread assumption that until eight weeks of foetal age the human embryo is immune to any brain damage effects of radiation. This is despite the fact that there was a significant deficit of births *seven* to nine months after the bombing, suggesting that doses of radiation were sufficient to kill embryos.

Finally, a total absence of childhood leukaemias in children born after inutero exposure to the A-Bomb is in direct contradiction to the findings of the Oxford Survey of Childhood Cancers (OSCC) which found a positive association between foetal irradiation and childhood leukaemia. This difference was originally ascribed to faulty interpretation of the OSCC data relating to prenatal x-rays. But work by my colleague George Kneale has shown that the latent phase of childhood leukaemia is characterised by an increased infection susceptibility. Coupled with the above mentioned probable lethal A-Bomb radiation effects on young embryos this suggests that the difference *is* more likely due to prenatal and post-natal death of the Japanese children, before an age when childhood leukaemia would become apparent

An alternative analysis

ABCC had collated data on sustained acute injuries effected by the blast, but considered the resultant variables of little value in analysis. RERF released the data to Knealc and he carried out his own statistical tests. If those with the highest level of multiple acute injuries are considered as the closest possible approximation to the original population, i.e. the unselected population, then findings for this subset might give some insight into the selective process.

Acute injuries were categorised as burns, oropharyngeal lesions, purpura and epilation. Using injury as a variable, various additional findings were uncovered: a strong association between injuries and leukaemia; doses sufficient to have non-cancer effects were not confined to those with obvious injuries, supporting our theory that sustained injuries included bone-marrow loss, leading to aplastic anaemia; a disproportionately high number of very young and very old people were among those with multiple injuries, which could be interpreted to mean that these people, most close to death, had been selected against by the A-Bomb.

The radiation community is of the belief that the A-Bomb data offer reliable risk estimates for all occasions. This consensus has lasted for thirty years and is now so strong that only risk estimates which conform with A-Bomb data are allowed to influence radiation safety regulations.

Potentially wrong risk estimates based on A-Bomb data may have consequences for recommended safe levels of worker exposure. Pooling of monitoring records of nuclear installation workers from three countries, the US, Canada and Britain, has resulted in no findings of any dose related cancer risk, according to researchers from the International Agency for Research on Cancer (IARC). The risk estimates agree with those from A-Bomb data. It has been noted, however, that the IARC researchers failed to appreciate that relations between exposure age and cancer risk are very different for workers and A-Bomb survivors, and they mistakenly assumed that the dosimetry standards within the nuclear industry arc sufficiently uniform to allow pooling of data from several facilities.

Work by Kneale et al has shown that if the data is disagregated and then analysed, evidence can be found of a cancer risk much greater than any A-Bomb estimate. Kneale has also shown that for workers in the US nuclear facilities the cancer risk increases progressively with age when exposed RERF has repeatedly shown from the A-Bomb data the exact opposite — that cancer risk was lower for those exposed at an age 50 years and over compared to those who were under 50 years at the time of bombing.

Clearly, application of A-Bomb data to very different sets of circumstances, flawed or not in its interpretation, is invalid

The supposition of no low dose radiation risk to early embryos, based on A-Bomb data interpretation, has obviously been influential in clinical practice. It is possible that the risk of foetal exposure has been dangerously underestimated, as evidenced by findings of the OSCC study.

Entrenched as it is in estimating cancer risk, A-Bomb data is showing no signs of being superseded in its use for setting safe exposure levels. It is still regarded as the gold standard. In its latest report, IARC makes no reference to the work of those proposing an alternative A-Bomb data interpretation.

Revisions of cancer risk estimations are bound to be sensitive, and no one wants to be alarmist. But if the nuclear industry persists in purporting its safety, surely there is an obligation for it to take on board the strong doubts as to the advisability of relying on A-Bomb data for the setting of safety limits for foetuses, young children and adults over 50 years of age.

Dr. Alia Stewart
Soft Energy 107,
December 1995—February 1996.

Trivialising Tricks

The Inside View from a Modern Believer in Human Sacrifice

Dr. Morris Rosen

Dr. Rosen, the author of this article is the director of the International Atomic Energy Agency (IAEA) Division of Nuclear Safety, and assistant director- general of the whole organisation. Some time ago, the French government in collaboration with IAEA organised a conference in Paris on "comprehending" radiation risks. The following is an extract from a speech Dr.Rosen made to the conference and shows very clearly the mindset which trivialises other people's suffering to sustains one's own high-flying lifestyle.

Comprehending radiation risks is a real and major problem confronting society today. Perhaps every professional working in this field has had experiences similar to one I will share with you. Frequently during my air travels, I enter into conversation with my neighbour — generally a well educated professional. In a few minutes he discovers that I am involved in nuclear safety and inevitably the conversation turns to questions about radiation and its health effects.

"What can you tell me about Hiroshima or about the vast environmental contamination caused by Chernobyl?" I begin my answers by explaining that as we speak we are being constantly bombarded by a broad range of radiation, not only from the cosmos but also from the food we are consuming. That seemingly new and troublesome point is followed by my comments explaining that the many victims of Hiroshima were not killed directly by radiation, but by the explosion and heat wave created from the nuclear detonation. Of the 80,000 survivors who received very high doses of radiation, less than 500 have incurred illnesses so far which are attributable to the radiation exposure - a statement that is also new and received with disbelief. But the figures are scientifically factual.

It is interesting to note that while (the average dose received by the Hiroshima survivors) is considered by Mr. Rosen to be very high, higher doses received by radiation workers are considered "acceptable and safe" by radiation experts like Mr. Rosen!

About 8000 survivors have indeed died from solid cancer tumours, but epidemiological studies indicate that less than 500 can be attributed to radiation effects. The remainder are normal tumours of the type that will threaten all of us, whether survivors of Hiroshima or not. It seems that most of us, even the professionals, do not realise or want to acknowledge that cancer is a very common occurrence. Twenty- five percent of us will incur a fatal cancer.

[What Rosen doesn't mention here is that radiation exposures produce an excess of so-called 'normal' cancers, not to mention other forms of dis-case and morbidity]

The answer to my neighbours second question concerning Chernobyl elicits the same disbelief. Certainly the fact that the entire environmental contamination of Chernobyl has produced a global radiological impact equivalent to an additional world exposure to 20 days of natural background radiation is more difficult to comprehend, let alone understand. The same is true of the health effects to the surrounding population which, except for the apparent, expected, and regrettable increase in thyroid cancer in children, will be sufficiently small so as not to be discernible through epidemiological studies.

[Especially radiological studies designed specifically not to pick up any excess in health effects like the IAEA conducted Chernobyl study which left out all the liquidators who were the people most at risk. It is also worthwhile to note that while Dr. Rosen how finds the 2500 % increase in thyroid cancers among children to be " apparent, expected and regrettable" he did not do so in 1986 when he wrote his first paper regarding the accident's consequences.

Why does my neighbour not believe me? [It would indeed need an extremely gullible neighbour who would!] Certainly, his perception of the facts is different from mine. Why? Many of us have been very pessimistic about our ability to deal with the public's perception of radiation risk. Radiation is mysterious; It is invisible, intangible, odourless, silent, and associated with warfare.

To explore this issue in more depth, the IAEA in October 1994

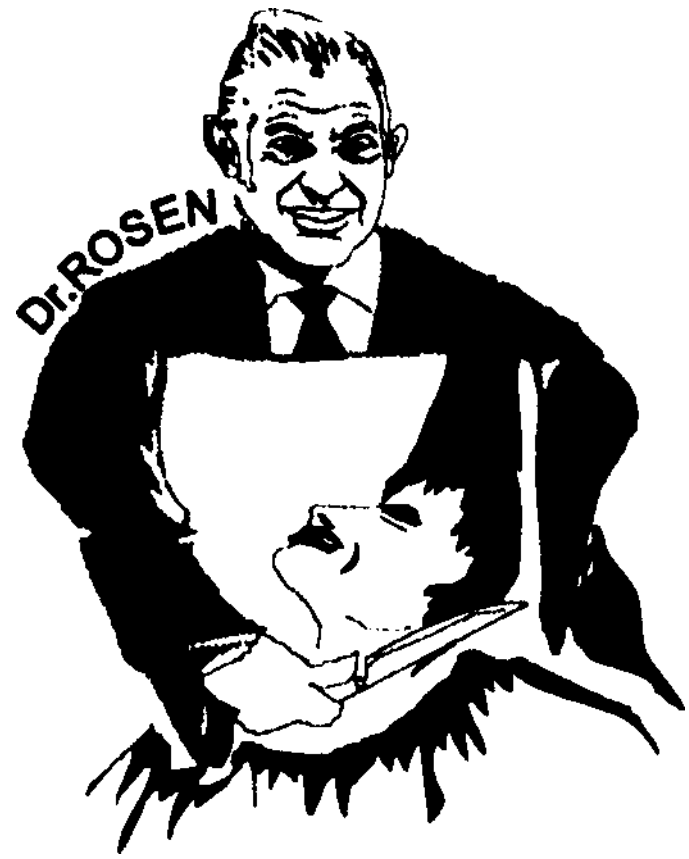
organised upon the invitation of France an International Conference on Radiation and Society: Comprehending Radiation Risk. It attracted more than 400 participants from 50 countries and nine international organisations.

The conference sought to bring about a better comprehension of the risk attributed to the exposure to ionising radiation. This is an important and serious subject for all of those concerned with the uses of atomic energy and ionising radiation for health applications, improving the food supply, generating electricity, and producing consumer and industrial products [vital items like radioactive golf balls from Atomic Energy of Canada Ltd, or radioactive black diamonds from our own Bhabha Atomic Research Centre].

The large audience—a unique mixture of technical specialists, social scientists, decision makers, and media professionals—was an indication of the high level of interest in radiation and how individuals and society perceive its effects. [It was also an indication of how avidly this class of people takes to free trips and hospitality at government expense!] The conferences goal was hot a further elaboration of technical information, but a better comprehension of radiation risk. And by comprehension, the conference had certainly desired to promote not only an understanding of the scientific facts of radiation health effects, but also and more importantly an ability to express these facts in a form useful to the public and the decision makers.

The goal was ambitious, perhaps too ambitious. The conference had only limited success in satisfactorily dealing with the question of the comprehension of radiation risk. Yet the concerned specialists may have gained some better insights as to where the roadblocks to better comprehension lie. There arc many.

Scientists too often speak to themselves and this pattern was very evident during many of the conference sessions. There could have been more efforts to present facts and conclusions in an understandable and communicative language. Some specific examples may be illuminating:



Dr. Rosen: Although the action of sharpened *steel* on the jugular does often regrettably result in death, just think you are the only case involved !

Victim: Hey! it is my life !

It would have been useful to further discuss the implications of some remarkable facts among the 80,000 survivors of Hiroshima. Fewer than 500 have so far incurred a fatal cancer attributable to radiation exposure- and the average loss of life expectancy among the survivors is about 1 year, while those that have incurred the fatal cancer have had their life cut short by 10 years.

[There arc a few other things Rosen could have mentioned here, including just what could he possibly mean by 'a fatal cancer attributable to radiation exposure' when it has surely been known for years that radiation exposure raises the probability of occurrence of all cancers, not simply those most attributable to radiation. In addition, it has been suggested that exposure to radiation increases the incidence of all diseases, 'radiation related' or not. The implications of the fact that radiation doses to Hiroshima survivors have in the past been overestimated, and that corrections to the dose received by them has resulted in considerable decreases in the quantity of radiation needed to increase the probability of a given health effect could also have been discussed, as could the fact that that more vulnerable people would have died quickly from blast and injury, leaving only the toughest to survive afterwards... indeed, all of these things, not mentioned by Rosen, could have been mentioned.

It would also have been desirable to discuss the reported thyroid nodule cases in the Marshall islands and in Nevada by not only confirming that large exposures to radioactive iodine produces cancer nodules, but by also referring to the rather relatively small number of cases involved (Sec Cartoon)

As for the Chernobyl studies, speaking about a 2500% increase in thyroid cancers in children ignores the importance of the accuracy of the pre- Chernobyl reference value for these studies, which surely involves major uncertainties. It would have added more to the comprehension of health effects to have expressed the results as five cancers per 100,000 children and to refer more precisely to the total number of cancers to be expected in the various regions. An unemotional discussion of the clinical outlook for these children would also have been useful.

[A little unemotional history would be of interest here. Before the

Chernobyl disaster there used to be barely one case a year of thyroid cancers in children in the Gomel region. After the disaster the number became 130. When doctors from Belarus reported this finding to the British scientific journal "Nature" it was denied publication because experts and scientists of the radiation community refused to believe "in the light of Hiroshima data" that so many thyroid cancers would become apparent so soon. However, the government of Belarus supported its doctors and asked for a team from the World Health Organisation to come and confirm the findings. It was only when this team did do so, that the results were allowed publication. By, now casting doubt on the reference value i.e. the number of cases occurring before the disaster, Dr. Rosen just wants to obfuscate matters. Also a statement like only five cancers per 100,000 children without simultaneously mentioning the 'normal' incidence of thyroid cancer is bound to mystify rather than clarify people's comprehension of radiation risks.]

There were a number of references to the cardiovascular effects of radiation. This effect must be clearly qualified by indicating the many compounding factors and the more likely cause, which is other factors such as stress.

[Indeed, stress is a factor in cardiovascular disease, as it is in cancer, and a number of other diseases. So also arc diet, the presence of carcinogens both chemical and radiation, and heredity. But Dr. Rosen seems to be trying to say that if stress is a factor, which it certainly is, then radiation cannot be—which is by no means true. Also there can be no doubt that a radiological disaster in the vicinity is bound to increase stress and it makes no difference to you whether you die or arc crippled by a heart attack that was "due" to radiation or due to stress induced by radiation.]

In the discussion of cancer clusters, such as leukaemia clusters, it is necessary to repeatedly emphasise that clusters always exist in nature. They have been found long before nuclear power existed and are also found in locations remote from nuclear installations - and in any case the number of excess cancers are few. Discussion of the Seascale cluster (reported in the 1980s in the United Kingdom) lingers on although most involved scientists believe it is not in any way connected with radiation. Why are the profound limitations of linking clusters to any cause not clearly and repeatedly stated? Furthermore, in much of the scientific community, epidemiology is recognised as an observational science with severe limitations. Epidemiological studies often involve small numbers of excess cancers with substantive compounding factors such that for most situations, positive as well as negative results must be taken with caution. The profound limitations of epidemiological studies must be clearly and repeatedly stated.

It's fair enough to call for humility and caution in interpreting a result. But the problem is that Dr Rosen will be much less humble and cautious when he thinks he has a result that exonerates radiation. The problem with the Seascale results seems to have been that the reported emissions of radiation from windscale/sellafield have been 'too small' to account for the observed effect under the official dose/response model, depending exactly which one we may use, as even the official model has seen very substantial downward revisions in the amount of radiation required to produce a given probability of a cancer, leukaemia, or other health effect. And if (as at Seascale) an unusually high incidence of a condition which even Dr Rosen recognises as 'radiation related' is happening in a community living next to a nuclear plant that is known to have leaked and to have had a very poor safety record, and if that incidence is especially high amongst children of plant workers who have been exposed to radiation as is the case at Seascale, then it really seems to be asking a lot of our credibility to say that the exposures arc 'not enough' to account for the result. It would really seem more probable either that more radiation has been released than we have been led to believe or that radiation is a much more potent agent of morbidity and mortality than we have been led to believe - or both.]

Rosen concludes:

The IAEA, together with the European commission and the World Health Organisation, has also organised a major international meeting in April 1996 to further look at the health and environmental consequences of the Chernobyl accident—10 years after the disaster. It is hoped that after the meeting, there will be a better comprehension of the radiological consequences of Chernobyl."

Indeed, one would hope this would be the result of such a meeting. Given the previous record of the IAEA in denying any real health effects at Chernobyl in spite of their grossest manifestations, and attributing the reports of vastly increased rates of not merely "radiation related' cancers , but dis-ease of all kinds to 'radiophobia', one cannot but wonder if this IAEA conference will be anything but a massively expensive exercise in whitewashing. A parallel alternative conference is also being held in Vienna and another in Kiev by the antinuclear movement just to ensure that an accurate picture has a chance to emerge.

M. Rosen Bulletin of International Atomic Energy Agency, Comments by John Hallam and Surendra Gadekar

The Rigmarole Regarding Radiation Protection

Do radiation safety standards protect health?

Dr. Rosalie Bertell

Originally, the US military thought that the radioactive fallout from their bomb tests would "only" spread over about half of the Northern Hemisphere. They found that the lethal cloud circled the earth about two and a half times. The three nations which had produced these bombs, US, UK and Canada had different radiation protection standards at the time, and they were afraid *of* some 'neutral' nation bringing a law-suit against them for the fallout The nuclear physicists from the three countries met between 1945 and 1950 to hammer out an agreement on "radiation protection" standards which could then be promoted globally. This committee of physicists was called the Tolerance Dose Panel, indicating a belief that people would be able to "tolerate" and adapt to increased radiation pollution in the nuclear age. The medical communities in both Britain and the United States were alarmed, and they organised two other investigating committees on radiation protection standards. In Britain, it was the National Radiation Protection Board (NRPB) funded by the government, and in the US a committee called BEIR - Biological Effects of Ionising Radiation, funded by the Rockefeller Foundation. The physicists decided that 15 rem (150 mSv) per year and 1.5 rem (15 mSv) per year for the general public was a reasonable trade-off between cancers likely to be caused by the exposure and the benefits of the activities which caused the exposure. At the time the "benefits" were atomic bombs. The NRPB and BEIR decided that 5 rem (50 mSv) per year for workers and 0.5 rem (5 mSv) per year for the general public was a more health protective alternative than that proposed by the physicists.

Radiation Dangers: Not a Novelty

Prior to 1950. radiation protection standards were based on protection against skin burns. It had been known since about 1912, however, that radiation also caused cancer. This became even more painfully apparent with the deaths of the deaths of the radium dial painters. In 1943, Hermann Muller received a Nobel Prize for showing that radiation caused genetic damage in fruit flies. During the 1945-50 period, several different biological endpoints were considered on which to base radiation protection standards: skin damage or other injuries, fatal tumours, general effects on blood, cataracts, obesity, impaired fertility, shortened life-span, or genetic effects. The committee decided to base the standards on fatal cancers, and since then the arguments have centred around just how many fatal cancers would be caused by exposure of the Standard Man to one rem (or equivalently 10 mSv) of whole body ionising radiation exposure. The carefully worded statement is: **What people should be concerried about after radiation exposure is fatal cancer." The* many other possible damages have faded into the background.

The International Commission for Radiological Protection

In 1928, radiologists had formed an international organisation to compare their experiences with exposure to medical X-rays and to protect themselves and their co-workers from harmful effects. In 1952, the Manhattan Project physicists who were trying to decide on common radiation protection standards approached this group of radiologists and suggested that they combine into one group. The physicists agreed to not ever limit medical use of radiation on patients, but only to set standards for worker exposure and exposure to the public from nuclear industries. They proposed their 15 rem limit but were ultimately prevailed upon by others to reduce this to 5 rem per year. The merger of these two group was called the International Commission of Radiological Protection (ICRP). ICRP now claims that it began in 1928, when the radiologists first organised, but that was a very different organisation.

ICRP is a self constituted organisation. Since 1952 it has maintained a membership of about 50% physicists and 50% medical doctors. The doctors have been about 25% medical administrators (often from nuclear weapon countries) who set radiation protection practices in their National Ministries of Health or Labour and about 15% medical radiologists. The other 10% has consisted of one pathologist, 2 geneticists and some biophysicists. By their rules, the Main Committee, responsible for all decision making, will not ever include an epidemiologist, occupational health specialist, public health specialist, oncologist or paediatrician. One can say that it consists only of users of radiation and administrators. These were approved by the Executive Committee of the International Radiologists Association at first, and then by the ICRP's own Executive Committee. Mem-

bership term is for an unlimited time. They have not mandated themselves to be protectors of worker or public health, but rather to recommend "sensible" trade-offs of health for the benefits of their activities.

By 1957 the ICRP got out its second publication, recommending that the internal radiation dose to workers and the public be limited to 5 rem (50 mSv) per year of any ingested or inhaled radio nuclides. The committee originally intended that this be a combined external plus internal dose limit of 5 rem (personal communication, Dr. Karl Z. Morgan, Chairperson of the Internal Dose Committee of ICRP). Actually, it was often interpreted to mean the worker could get both internal and external doses per year. There was another abuse related to internal contamination, i.e. when radionuclides were ingested or inhaled and became incorporated into bone. The nuclear experts counted only the 4 or 5% of total dose delivered the first year and then forget about the subsequent years. Slowly delivered doses due to bone incorporation could continue for 50 to 60 years.

ICRP Publication 2,1959 states:

"The permissible dose for an individual is that dose, accumulated over a long period of time or resulting from a single exposure, which, m the light of present knowledge carries a negligible probability of severe somatic or genetic injuries, furthermore, it is such a dose that any effects that ensure more frequently are ~~limited~~ to those of a minor nature that would not be considered unacceptable by the exposed individual or competent medical

It is important to note several things: First dose rate is not considered to be important; second only severe effects are prevented, and third, the probability of more frequently experienced effects is admitted but dismissed as *not unacceptable.* The recommendations are resting on several value judgements and not on objective norms protecting health. Effects of a *minor nature* include non-fatal cancers, embryonic and fatal loss, still birth and congenital malformations or diseases which are not inheritable.

The Debate Regarding Genetic Damage:

On 6 February 1947, Professor D. G. Catchside, member of the Faculty of Botany at Cambridge University, prepared a memo on: "the genetic effects of irradiation with reference to man", and sent it to the British Medical Research Council subcommittee on radiation protection standards. He testified that even the smallest dose of ionising radiation caused genetic effects. His own experiments included doses down to 0.1 rem (1 mSv) per day on mice. All genetic effects from X-ray or gamma rays were cumulative, either additive or proportional to total dose. Even when the dose rate was lowered, genetic effects were additive. He was concerned about the doses to human ova and sperm.

Catchside was answered by Dr. D. E. Lea in a memo to the Medical Research Council dated 28 April 1947.

"In writing this memorandum I assume members of the panel to be familiar with and accept the survey of Genetic Effects of Radiation prepared by D. G. Catchside." He suggests accepting the observations but not trying to prevent the problem since: It will not be possible to prove whether any particular instance was caused by radiation, so no question of liability for compensation can occur." Lea stated this twice, first with respect to deleterious effects caused by recessive gene mutations and second, with respect to semi-sterility. Lea concludes: "so long as less than 1% of the population is exposed to radiation then is not likely to be a noticeable increase in of hereditary abnormalities."

Apparently this dialogue was passed on to the Tolerance Dose Panel of nuclear physicists, because they held a meeting on genetic effects in April of 1948. No minutes are available from this closed meeting. Some members of the Tolerance Dose Panel went on to found the ICRP, and were members of the Main Committee when the question of genetic effects surfaced again in 1957.

Professor Catchside delivered a paper, "Genetic Effects of Radiation" at the Conference on the Biological Hazards of Ionising Radiation at Cambridge in 1950. He stated clearly:

"There is no threshold, no time factor (latency period) and no recovery".

"The genetic defects would consist in part of obvious and gross ones and in fart of the minor ones which tend to reduce the fitness of many apparently normal individuals. The latter effects may well be rather considerable and more important from the point of view of the species as a whole. The total effect may well be very serious or even disastrous.[39]

The same caution was echoed by Hermann Muller, who was by that time a member of the ICRP Main Committee. This position is detailed in: "Radiation and Heredity", American Journal of Public Health, Vol.54 No., pp 42-50, 1964, in an article which Muller published.

While both Catchside and Muller based their concerns on animal and plant studies, I had reached the same conclusions after studying the effects on medical diagnostic x-ray exposure. In the childhood leukaemia data, leukaemia was a late-death phenomenon. What I mean by this is that large numbers of embryonic and foetal deaths, neonatal or infant deaths also occurred in the infant group. The number *of* such deaths was significantly higher than the losses in the unexposed group. The final deaths in the birth cohort occurred after one year of age and were leukaemia (or other cancer) deaths up to age 15 years. I reported this in "Radiation Exposure and Human Species Survival", Environmental Health Review, Vo.25No.2(1981). My reasoning was that if medical x-ray during pregnancy was so lethal, it was very likely that many more babies who survived were damaged in some way. After exposure to a trauma capable of killing, it is unlikely that survivors had no residual problems. These were of course, hard to detect since there was no way of knowing the potential health of the offspring had they not been irradiated.

It was Professor K. Mather, Department of Genetics, University of Birmingham, UK, who answered the objection that there would be a "slow loss of fitness in the population" with chronic exposure to radiation. Mather takes courage in the "fact" that no more than 1% of the population would be exposed to radiation, but this was before the spread of nuclear technology and the fallout from nuclear testing programmes globally. He noted that:

"In particular, in human society, the fate of an individual is not independent of the activity of his fellows ... If his fellows take steps to alleviate his lot, his selective disadvantage will, at least in some cases, be reduced and bis contribution to the next generation increased... The point to be made clear is that, in the cast of man, discussion of the effect on the community of raising the mutation rate cannot be deponed from consideration of changes of possible with other species." In Biological Hazards of Atomic Energy, edited by A. Haddow, and published by Oxford Clarmdon Press in l952).

This is the old discredited argument of eugenics. In its more modern form, it advocates amniocentesis during pregnancy and abortion of genetically inferior offspring. This docs not change the reality of the damage to the human gene pool. It only kills the victims who are most easily identifiable. There will be many more who will not be identified for years after their birth. The genetic load of the species will increase, and as Einstein said in 1945: "we will have fewer geniuses".

The Importance of Kerala Studies

The Atomic Bomb data has been recognised for many years as being inappropriate for the study of genetic effects of radiation. The United States National Academy of Science Committee on the Biological Effects of Ionising Radiation (the BEIR Reports) normally uses mouse studies for their risk estimates, although their cancer estimates arc based on the Japanese data. BEIR III (1980) contains a section called "Advances in Knowledge Since 1972" (pages 74-79). In this section the committee says, with respect to genetic damage:

"We cannot ignore such mild mutations... taken over the whole period and in conjunction with other mutants, their effect may be far from negligible. Despite a concern fir this effect, we shall not attempt estimating it quantitatively..

"In contrast to somatic effects, where the concern is concentrated mainly on malignant disease, the genetic effects are on all kinds of conditions, for the spectrum of radiation-caused genetic disease is almost as wide as the spectrum of all other causes.[v]

Recently the BEIR Reports have used atomic bomb data to support their theory that humans have undetectable genetic damage from the atom bombs. As early as 1957, the World Health Organisation called together a Committee to study the genetic effects of radiation and to recommend protection of the human gene pool. In the publication by this Committee, Kerala, India, was identified as the best place to study the genetic effects of chronic radiation exposure over several generations. To date, the nuclear establishment has not undertaken a serious study of this population, indicating their lack of concern for genetic damage. In one study, undertaken for another purpose, the authors noted that the exposed population of Kerala had an abnormally high rate of Down's Syndrome. Researchers also found significantly higher levels of broken chromosomes in the exposed group. In 1988, with the help of Indian re-

searchers, I agreed to act as scientific advisor to a study of the people of Kerala. Researchers found that they were the first group to interview and examine the population, although the nuclear industry often uses Kerala as its example to "prove" that low level radiation is harmless.

We now have measurements of the background radiation at grid points all through the contaminated area, detailed information on about 32,000 exposed households and matched control households not living on contaminated sand, and information on 92,000 pregnancies. Our preliminary findings are that the rate of Down's Syndrome is 3 to 4 times higher in families living on the radioactive sand than for control families. Other problems which were more than doubled for the radiation exposed group were: congenital blindness and deafness, epilepsy, malformation of long bones, childlessness (couples who wanted to have children but could not), and various kinds of degrees of mental retardation. In the communities living on the contaminated soil every one of the so called sentinel mutations, rare genetic damage, was found This was not true for the matched controls. We are still trying to raise money to complete the detailed analysis of this important data.

In my opinion, all future radiation protection standards should be based on damage caused to future generations. This will significantly lower the limits of exposure which are now officially considered "safe". It has serious implications for further plans to expand the nuclear industry and for the management of nuclear waste.

HOW MANY DEATHS ARE "ACCEPTABLE"

In basing radiation protection recommendations on fatal cancers, the ICRP makes a decision on how many cancer deaths per year arc "acceptable" for the activity (building nuclear bombs, generating nuclear power or caring for a patient with a radium implant). The fatal cancer risk is an estimate of how many cancer deaths arc expected for an exposure to 10 thousand Person Rem, or equivalendy, the exposure to 100 Person Sieverts. Prior to 1990, the official cancer estimates for this exposure were 1.25 (ICRP) or 1.00 (UNSCEAR - United Nations Scientific Committee on Atomic Radiation). I think that UNSCEAR merely rounded the numbers of the nearest digit.

There are also international guidelines for "safe industries", for example a chemical plant, which state that in a safe industry there will be no more than one death per ten thousand workers per year. A safe industry in a city is one which causes no more than one death per million people per year.

If one examines the ICRP recommendations for whole body exposure which govern the nuclear industry between 1952 and 1990, one finds that the maximum permissible dose to workers was 5 rem per year. If 10,000 workers annually receive that dose, the industry would cause 50,000 Person Rem exposure or five fatal cancers (using their risk numbers). Yet, they have never acknowledged this to be a hazardous industry. Instead, they claimed that workers only received an average of one rem per year not five rem, and therefore only one cancer death per 10,000 workers per year would be caused.

In 1990, the ICRP, after reassignment of doses to atomic bomb survivors and pressured by scientists and medical professionals globally, moved their risk estimate to 5 fatal cancers per 10,000 Person-Rem. This again makes the nuclear industry "hazardous on at one rem per year average exposure. It means that five fatal cancers are caused. The ICRP lowered its maximum permissible dose in 1990 to two rem per year, averaged over five years. Using their figures, this means a commitment to ten fatal cancers for nuclear workers per year is considered by ICRP to be "acceptable". Since 1984, the ICRP has admitted that its recommended exposure limits were: the upper limit above which everyone agrees that it is hazardous. Prior to that, the limit was considered a threshold below which exposures were considered safe.

The recommended maximum exposure for the members of the public at risk from nuclear industries was 0.5 rem per year in 1952. If one million people actually received this dose it would be 500,000 Pcrson-Rcm exposure. Using the ICRP risk estimate, this means 50 to 62.5 fatal cancers. This is a very unsafe standard even using ICRP calculations. The ICRP claimed that the maximum dose to the public was only one percent of that recommendation, hence the industry was "safe", but they would never lower this permissible dose. The one percent always referred to the reactor phase of the cycle (and was never demonstrated to be true when all radionuclides and all pathways to human were taken into consideration.) It was never claimed for uranium mining, milling or for nuclear waste.

In 1984, ICRP recommended that exposure to the public not average more than 0.1 rem per year. They did not specify the length of time this average was to extend Many governments, including Canada, averaged over the lifetime of the person (70 years) and thereby allowed

higher per year levels around nuclear reactors only expected to operate for 35 to 40 years.

In 1990, the ICRP risk estimate was changed to 5 fatal cancers and the maximum dose to the public averaged over five years was recommended to not exceed 0.1 rem. This is a commitment to 100,000 Person-Rem or equivalently to 50 fatal cancers per year. This is a very hazardous industry even under the assumptions which ICRP deem "acceptable".

Fatal Cancer Risks Based on Scientific Literature

The ICRP risk estimate is based on a double reduction of the observed fatal cancer risk at Hiroshima and Nagasaki. Under the same standard conditions, 10,000 Person-Rem, Dr. Preston, Research Director of the RERF at Hiroshima, estimated that 17 fatal cancers were caused using direct linear extrapolation from high dose. According to Dr. Preston, UNSCEAR 1988 report reduced this estimate because of a low-dose-factor to 7 to 11 fatal cancers. ICRP took the estimates from BEIR (8 to 14) and UNSCEAR 1988 (7 to 11), which averaged about 10, and divided them by 2 using a slow-dose-factor. Hence, the ICRP estimate of 5 is really quite low even based on atomic bomb data. The reduction of the estimate for low dose and slow dose rate has never really been shown to be a valid process. In fact, the most recent studies of nuclear workers, who actually received low doses at slow dose rates, indicate that the correct estimate would be around 20.

With a risk of 20 fatalities due to radiation exposure of 10,000 Person-Rem the "acceptable" number of deaths per year at 2 rem average exposure for workers and 0.1 rem average exposure for members of the public would be

Workers: 10,000 workers x 2 rem / year x 20/10,000 Person Rem - 40 cancer deaths / year

General Public: 1 million people x 0.1 rem/year x 20 / 10,000 Person rem = 200 cancer deaths per year

This is of course quite different from the claims of the industry, and from "evidence" of poorly designed studies which the industry claims back its estimates. It should be remembered that these numbers arc radiation initiated fatal cancers which may take years to develop and to be diagnosed. By the time all of the cancers arc "seen" the nuclear facility will be moth-balled and the operators gone.

Annual Limits of lntake

The nuclear industry routinely emits radioactive chemicals into the air or water in the vicinity of a plant. It is difficult to regulate a mixture which is ever changing, so these radioactive chemicals are regulated one at a time as if the total permissible dose for the year was obtained from one radioactive chemical and via one pathway. Assuming that the Standard Man (a twenty year old Caucasian male in good health) has a standard breathing rate and inhalation and drinks a fixed amount of water every day, these estimates are converted into maximum permissible concentrations of the radioactive chemical in air or water. The concentration permitted would give the Standard Man the maximum permissible dose in one year. These number can be modified for Asians, for women or children, for various combinations of radioactive chemicals etc. These are the derived limits for cumulative releases from nuclear reactors. However, inhaled or ingested radioactive chemicals also pose special problems. They often arc dispersed differently in the body. For example radioactive iodine concentrates in the thyroid glass and cacsium in muscle.

Recently the ICRP has invented the Cumulative Effective Whole Body Dose, which accumulates the dose expected from the radioactive chemical over the next fifty years of the person's life the organs affected, and the whole body dose which would cause the same number of fatal cancers. This methodology seriously neglects non-fatal cancers. For example only 5% of thyroid cancers and less than 1% of skin cancers are considered fatal. These non-fatal cancers are allowed under the radiation protection schema.

For every 20 fatal cancers caused by radiation, about 10 non-fatal no-skin cancers and 20 skin cancers will be caused. It is certainly not clear that these non-fatal cancers should be ignored when "protecting" people from radiation!

This puts the nuclear industry in an even higher risk category when its permissible exposure levels are attained. It is assumed that 100 cancers will be caused per 10,000 workers per year, 40 of which are expected to be fatal. For the general public it means 500 cancers per million people per year, 200 of which arc expected to be fatal

As pointed out earlier, this does not include the other more frequent effects of exposure judged by the nuclear experts to be of no concern to people. These include autoimmune diseases and depressed cellular immune system. The latter leaves the person vulnerable to the more serious viral and bacterial infections and less able to cope with cancers caused by other factors.

A *New Approach to Radiation Research*

When the radiation exposure level is low, i.e. within an order of magnitude of natural background radiation, I believe that it is best understood as contributing to the effects of that background radiation. Over time the human body "ages". Ordinary diseases come more frequently and last longer. The ability to overcome fatigue and illness is lessened Cancers and autoimmune disease incidence rate increases. Not all of the characteristics of old age arc connected with background radiation, but certainly some arc. Chronological age is a good measure of cumulative background exposure to ionising radiation.

The acceleration of some of the components of ageing can explain a part of the problems experienced by those exposed to radiation, for example, the earlier occurrence of breast cancer in young women under age ten at the atomic bombings, and the adult illnesses observed in Chernobyl children. It can open new ways to understand the subtle chronic exposures which accumulate over a lifetime and finally lead to death because of our inability to deal with our environment. The natural process can apparently be accelerated by increasing radiation exposure levels.

Some phenomena arc not repeatable, and radiation exposure becomes redundant, or useless for producing that effect. An illness like adult onset diabetes for example, is an old age disease which one cannot acquire more than once. Therefore, one can expect lessening of the effect of radiation on ageing as the cumulative dose increases. However, at higher doses, direct damage to vital organs and direct induction of cancer can be expected to increase. I believe that there arc complicated and competing effects of radiation, the ageing effect being predominant at the low doses.

Can the ICRP be trusted to set radiation protection standards?

The obvious answer is no. I think that it is time to disassociate ourselves from this self-appointed recommending body. Firstly, it docs not have as its goal, protection of worker and public health. Rather, its goal is to recommend the "acceptable" trade-off of that health for the benefits of nuclear industries (medical, commercial and military) which it represents. In the fifty years since the formation of the ICRP it has never taken a stand on behalf of worker or public health, even against such obvious violations of human rights as non-ventilation of underground uranium mines and nuclear atmospheric testing.

It is also possible to fault the ICRP for its non-democratic structure. It is a self-appointed and self-perpetuating non-gove r nme n t al organisation. Its behaviour does not follow that of usual scientific bodies.

The ICRP, moreover avoids all responsibility for its recommendations. It claims that it merely makes recommendations, which then become the responsibility of individual nations to either implement or modify as they see fit. However, it is evident that most nations lack the financial and scientific capacity to counter the unlimited resources and international prestige of the ICRP. Politicians and bureaucrats, with low scientific literacy, take the easy way out and adopt these international recommendations.

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WORLD COURT DECLARES NUCLEAR WEAPONS' THREAT AND USE ILLEGAL

In a landmark decision on Monday, 8th of July, the International Court of Justice declared that the threat and use of nuclear weapons would be "contrary to the rules of international law applicable in armed conflict" in just about any imaginable circumstance.

The only exemption to this sweeping declaration of illegality was the court's holding that "in the view of the current state of international law and at the elements of fact at its disposal, the Court cannot conclude definitively whether the threat or use of nuclear weapons would be lawful or unlawful in extreme circumstances of self-defence, in which the very survival of the state would be at stake."

The single vote on these two provisions was seven to seven, with the president casting the deciding vote. However, since three of the ~~dissen~~ting judges did so because they took the complete illegality view and did not agree with the possible "extreme circumstance" exception, the vote for general illegality was, in effect, ten to four.

The court unanimously stressed that, in accordance with Article VI of the Nuclear Non-proliferation Treaty, "there exists an obligation to pursue in good faith and bring to a conclusion negotiations leading to nuclear disarmament in all its aspects under strict and effective international control"

The Court was also unanimous that nuclear weapons, like any weapons, are subject to the law of armed conflict protecting civilians, combatants, the environment, neutral nations, and succeeding generations from the effects of warfere, as well as United Nations Charter prohibitions of threat or use offeree except in self-defence.

Peter Weiss, co-president of the International Association of Lawyers Against Nuclear Arms, welcomed the Court's opinion, stating, "This was an appropriate sequel to Wimbledon, with a group of unseeded states, carrying the day against the world's top seeds. The court has charted a clear path toward nuclear abolition, in terms both of its legal analysts and its appeal to start taking Article VI of the NPT seriously."

Commander Robert Green, Royal Navy (ret.), of World Court Project UK, said: "With this remarkable decision, I could never have used a nuclear weapon legally. This places a duty on the military to review their whole attitude toward nuclear weapons, which are now effectively in the same category as chemical and biological weapons."

In response to a request for the advisory opinion from the World Health Organization concerning the legality of use of nuclear weapons in view of their health and environmental consequences, the Court found that it has no jurisdic-

tion because the legality of nuclear weapons is not within the scope of WHO activities. Ann Marie Janson, WHO liaison for International Physicians for the prevention of Nuclear War (IPPNW), commented that, This case was initiated by the WHO, with a boost from IPPNW, which understands that prevention is the only medical response to the threat of nuclear war. We are happy that the court referred to the need to protect the environment and future generations from nuclear damage in the General Assembly case, but we are disappointed that these same health aspects were understood only by the three dissenting judges in the WHO case."

The Court's opinion in the General Assembly case comes as a blow to the United States, United Kingdom, France and Russia, all of which urged the Court not to consider the case. The case was initiated by international peace and disarmament groups including the International Association of Lawyers Against Nuclear Arms (IALANA), International Peace Bureau (IPB) and International Physician! for the Prevention of Nuclear War (IPPNW). Not having direct access to the World Court, they successfully petitioned the World Health Assembly and the United Nations General Assembly to make requests for advisory opinions. Predrik Heffermehl of IPB stated, "This case is an encouraging example of the ability of people's organisations to make use of international institutions like the World Court, which are meant to serve the world's people and not their governments."

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From The Editor's

The Moral High Ground

Some people, just a very few, are moral. Many more are moralistic. To be sure some moral people are also moralistic. Being moral necessarily implies that one's conduct is governed by certain principles which one adheres to, even when, as they say, the going gets tough Being moralistic means that one demands moral conduct from others regardless of whether one is moral oneself or not.

Moral people are quite often exasperating to those around them. It can be annoying some times to adhere to a high moral standard expected of oneself especially when the outcome is likely to be not in one's immediate interest. And yet moral people however exasperating and however exacting their standards do command universal respect. Such a one was Gandhi. He was called many things in his life but even his most antagonistic adversaries respected him for his commitment to principles.

India, the nation which has officially enshrined Gandhi as the father of the nation, has preferred in its dealings with the world outside to be moralistic rather than moral. And whatever respect one may have for moral people, moralistic people with their sanctimonious lecturing are just a pain in the hind quarters.

Indian insistence on universal nuclear disarmament is a sound principle. But our advocacy of it would command respect if and only if we ourselves believed in nuclear disarmament and renounced in a legally binding way any intention of ever producing a nuclear weapon. This should not be too difficult. The World Court has already declared threat and use of nuclear weapons as illegal. For weapons which can never be detonated, nuclear weapons do cause tremendous destruction of the population whose supposed security is the cause of so-called cause of their production. The books we have reviewed in this issue bear ample testimony to prove this point.

Nuclear bramhacharya is not the abstinence of the weak. Like the real thing it does take some doing. But like bramhacharya supposed does, it too would confer unimagined power. It would allow the country to capture the moral high ground and lead an assault with rest of the world against the thuggery of nuclear powers and their international (dis)order. But those who have become used to scurrying around the nuclear high-table (security council) with their tongues almost touching the ground, hoping for an invitation or may be any odd crumb are not the ones to do it. The least they can do is stop being moralistic.

Surendre Gadtkar

Finding the Re-engineering of the Dome at Kaiga Too Difficult

DAE Re-engineers the Regulatory Board

L'Affair Gopalakrishman, in which the Department of Atomic Energy unceremoniously and shabbily remand Dr A Gopalakrishnan from the chairmanship of the Atomic Energy Regulatory Board, has keen too much in the news to require special coverage in Anumukti. On the next page we have an editorial assessment cf Dr Gopalakrishnan's tenure. The following is an edited version of an article of his where he describes the impasse which has stalled the construction of reactors as kaiga and Rawathbata.

On May 13. 1994, the under surface of the pre-stressed concrete dome in Unit-1 of the Kaiga nuclear power plant collapsed during the final stages of construction. The two 220 MW reactor units at kaiga and two similar units of the Rajasthan atomic power project I (RAPP 3 and 4) which are all under j construction, are to I use the same dome design In view of this both the Nuclear Power Corporation (NPC) and the Atomic Energy Regulatory Board (AERB) urgently constituted separate failure investigation committees to go into the reasons for the Kaiga failure. Both these committees submitted their reports by May 1995. More than two years have passed since the dome collapsed, but till today the NPC and the Department of Atomic Energy (DAE) have not finalised even the design basis for the re-engineering, let alone a revised design. Construction of the containment structures at all the four reactor projects is at a halt.

The loss of electric power generation due to this delay at the Kaiga unit-1 and 2 alone will amount to Rs 800 crores so far. Similar loses at RAPP-3 and *4* can be estimated at about Rs 500 crores. These do not include the large additional interest expenses the DAE has incurred on borrowed capital. In addition, there is a multiplier effect through the loss of industrial production as a result of non-delivery of electric power to various parts of Karnataka and Rajasthan.

The New Watch-Dog

The AERB investigation committee which examined the causes of the Kaiga dome failure included some of the best experts in the country in the fields of pre-stressed concrete design/ construction methodology and quality assurance. They carried out extensive independent analysis of the dome, examined material test data and studied the voluminous inputs provided by all the concerned parlies before finalising their report. They reported the cause for the collapse based on analyses and corroborative evidence. The investigators have also stated the deficiencies in the design that eventually led to its failure. A set of indirect factors which point to the need for improvement, were also included in the report. The Atomic Energy Commission (AEC) discussed the investigation reports of the AERB and NPC committees in July 1995. They accepted the AERB report and directed the NPC to follow its recommendations while carrying out the re-engineering of the inner containment structure. Why, in spite of this directive given one year ago, should the impasse continue and the NPC be unable to proceed with the task?

Unfortunately, these findings of the AERB investigation on the Kaiga dome failure could not be disclosed to the media or the public because the DAE opposed such action, even though the report does not contain any information or data of a proprietary or secret nature.

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On certain critical design aspects, the NPC is seeking deviations and concessions from the AERB beyond acceptable limits. While deviations could be allowed to a certain extent, it is incumbent on the designer to provide either analytical or experimental evidence to the

regulatory body to prove that such departures will not have any adverse impact on the safety and integrity of the structure. NPC is yet to satisfy the AERB in this matter.

It appears that the re-engineering of a pre-stressed concrete dome with four large openings, to match an already constructed cylindrical wall with pre-fixed stressing cable locations, is becoming too complex a task for the NPC. This could be the reason why the NPC is considering various alternate concepts of dome design even at this stage.

Leaving matters to be decided

Whenever a major failure incident occurs, it is common practice to fix the responsibility for the failure, if detailed investigations provide a sufficient basis for doing so. Following the serious fire incident at the Narora Atomic Power Station Unit-1 in 1993 and the Kaiga dome failure in 1994, AERB investigation committees had submitted detailed reports on the causes of these incidents to the DAE. These included the omissions and commissions that could have contributed to their occurrence. But the DAE has so far not fixed any responsibility for these incidents, though the resulting economic loss in each case is more than few hundred crores of rupees. An essential step in building up a safety culture is to reward those who contribute to the enhancement of safety and extend just reprimands and penalties to those who have clearly neglected their safety responsibilities. Not doing this in the case of the Kaiga incident is also one cause of the present difficulties.

Dr. A. Gopalakrishnan
Former Chairman,
Atomic Energy Regulatory Board
Times of India July 25,1996

Dr. A Gopalakrishnan:

Dr. A Gopalakrishnan was not the first chairman of the Atomic Energy Regulatory Board Dr. A K De and Mr. S D Soman preceded him in that chair. Both these worthies knew very well that they held their offices at the pleasure of the chairman of Department of Atomic Energy. They therefore cut their sails accordingly. In fact, Mr Soman when asked to investigate certain wrongdoings in the Department of Atomic Energy, slunk away abroad for 'treatment' and then whiled away the little time left before retirement The least that can be said about Dr. Gopalakriahnan's tenure is that he did try to take the watchdog role of AERB seriously. The fact that two years after the thankfully unique collapse (sorry "delamination") of the containment dome at Kaiga, construction of the roof has still not got AERB's OK, is a tribute to Dr. Gopalakrishnan's sense of responsibility as well as his tenacity in standing up to DAE pressure. He also deserves praise for proceeding with regulation of X-ray units whose unregulated proliferation does constitute a great health hazard His performance after the fire at Narora in 1993 when he forced stoppage at other nuclear power plants to check if they too suffered from the same fault, was also exemplary and it did come up with faults in the turbine blades at Madras which prevented similar fires there and in other places. He deserves the nation's thanks for having tried to regulate with extremely limited powers of his office, the monster created in the name of nuclear power.

Having said all this, it must be added that the most that can be said of Dr. Gopalakrishnan is that he tried. There can be no doubts regarding his failure. The acrimonious manner of his departure just shows that nucleocrats remain as smug and self satisfied as ever and the danger to common people from their activities is as great as ever. They are likely to brush aside the Gopalakrishnan years as an unhappy episode when their misdeeds were sometimes exposed to the public gaze. They are also likely to be extra careful in future appointments of members of AERB. Thus, the impact of Dr. Gopalakrishnan's tenure over the long run is likely to be negative. The blame for this lies not only with the nuclear establishment but also to some extent with Dr. Gopalakrishnan himself. He did not (probably by choice) and while he had the opportunity, make changes in institutional procedures which would have ensured continued openness and accountability at least in the AERB. His successor in a press conference has had the cheek to say that, "If I am saying that we are making progress, you have got to believe me." Dr Gopalakrishnan's claim that " he believed in keeping the public informed about nuclear safety matters to instill confidence in the transparaency of operation" now rings hollow. A person more committed to openness and transparency and less obsessed with personal self-promotion could have, even with limited powers, left a better legacy.

Germans Say No to Nuclear Waste Dump

Wendland is a nose shaped region of Lower Saxony that juts out in what used to be East Germany. In the days before the reunification of Germany, West German nucleocrats thought it to be an ideal place for storing nuclear waste. The region was sparsely populated, not industrially 'developed' and hence by definition 'poor'. In case of accidents or leaks, the consequences would be borne by their 'brothers' across the border. Thus, it satisfied all the time honoured criteria of nuclear operations: to find a weak and defenceless population which cannot protest, and 'develop' it into the modern age. But as Burns said it so well- "The best laid plans of men and men.," With no consideration for the consequences, the Soviet empire collapsed and the always hoped for day of German unification arrived in the lifetime of those who had, whatever the hopes and the rhetoric, never expected ii to happen. From being in a remote region in the forests in a corner of the country, Gorleben (the village where the waste repository is located) in now right in the middle, easily accessible from all sides. This backward' rural region is quite satisfied with itself and does not care for nuclear 'progress'. Each and every farmhouse in the region has the sign CastorNIX painted on it. Last year when the first Castor arrived carrying its load of nuclear waste, the authorities found that all the villages in the regions had repainted their names as Gorleben. This caused a great confusion in police who were unfamiliar with the region.

Castor and Pollux -the heavenly twins-are two legendary Greek brothers, who were inseparable. They had a fight in which Castor being human died while Pollux who was the son on Zeus the king of the gods, survived. On being offered immortality, he refused if Castor was to have no part of it. The final solution was that they lived half the time in heaven and the other half in hell. Why, the container is called Castor is obscure to me. Perhaps it has to do with the fact that the container is of a modular design which fits in with another part-the Pollux-which can be lowered into the earth. Or may be nucleocrats (who live in a heaven of their own) have inadvertently hit upon the truth: In a new twist to the old tale, a few live in heaven whereas there is hell on earth due to nuclear waste! The following two reports describe the resistance to the May 8,1996 movement of nuclear waste shipment from Le Haugue in Prance to Gorleben in Northern Germany. 19,000 policemen were deployed from all over the country to in order to ensure the shipment reached its destination.

After the first Castor shipment last year those expecting the resistance to decrease found they were mistaken. Not only in Wendland itself but also all along the transport route the resistance has increased since last year. Another shipment was due to come this year from the nuclear power station at Gundremmingen in southern Germany but this was cancelled, apparently because the police did not think they would be able to "protect" it.

The Castor train carrying the high-level radioactive waste left the French reprocessing facility at Le Hague on its to Gorleben sometime in the evening of May 6. It had already been decided by groups campaigning against the shipment in Germany that there should be no obstruction of the train at the Franco-German border, in order to avoid giving any wrong nationalistic signals.

Soon after crossing the border, the Castor encountered its first resislance-a camp set up across a level crossing in W6rth. The police had to clear the tracks before the train could proceed.

As the Castor train made its way across Germany it symbolised the nature of nuclear state, with an advance party of police and engineers making preparations to clear the route ahead, at least three police helicopters flying in formation in front of the transport, and finally the transport itself, heavily guarded on all sides. Level crossings were closed 15 minutes before the arrival of the train, and police were monitoring all the bridges and level crossings along the route. It was like a military operation through hostile territory.

Despite the police presence, people managed to get onto the tracks in a number of places. In Darmstadt, Minden, Altenbeben and Gottingen, the train was blockaded There where
actions in many other cities, not,
even on the route of the Castor-Landau, Mainz, Bingen, Erlangen, Marlberg, Tri , Konblez, Sprenkling, Verden, Bielefeld, Bad Hersfelu, Bochum, Bonn, Dusseldorf, Dulsberg, Koln..

Dannenberg: End of the Line

Dannenberg is the end of the train line where each Castor must be lifted by a huge train on to a low loader lorry for the final stretch by road to Gorleben. Despite the banning of demonstrations there, 10,000 people held a rally in the town centre on May 4. They then marched to the main street and blocked it creating the slogan "Wir stellen uns quer" (We are blocking your path) by forming giant letters out of groups of people on the street.

On Tuesday, 6th May, 1800 peopre repeatedly blockaded the low-loader as it was being prepared for the journey. The police became very brutal with the demonstrators who included local farmers blocking the route with their tractors. The next day police took pre-emptive action against tractor blockading by vandalising 150 tractors that were packed in a nearby forest. Windows were broken and tires slashed.

Day X2: Military Tactics Force the Waste Through

Castor was due to arrive in Dannenberg at 4.00 AM on 8th May. However, a small group of demonstrators managed to hold the train for half an hour just outside the town. When it finally arrived, there were four thousand people waiting for it near the loading crane. What followed then was a forcing through of the Castor with water canon and riot police. (See Next Story)

Andreas Speck
Peace News June 1996

Wir Stellen Uns Quer (We put Ourselves on the line)

2.30 AM the Castor train reached Uelzen, lower Saxony. We try to reach the tracks, but the police stand shoulder to shoulder in riot clothing, equipped with shields and long truncheons. Their lines are impenetrable. Several water canons and ready and a helicopter circles overhead, accompanying the shipment.

The Castor sets of along the tracks-used only for Castor shipments—towards Dannenberg. Each brige and railway crossing is *guard*ed by police. In the flat open land near Dannenberg the headlamps of the convoys of the police vans rush through the darkness towards Dannenberg or Gorleben. Above, a helicopter circles with a powerful searchlight.

longer possible to prevent the storage of the second Castor in the above ground building which is designed to contain the planned 420 Castors. Nonetheless, we will do our utmost to increase the costs of the transport.

At 5.56 AM the Castor arrives in Dannenberg. It is lifted by a crane onto a waiting lorry. The 18 km road journey from Dannenberg to Gorleben begins. Thirty police vans, six water cannons, and several bulldozers precede the Castor while three thousand police accompany it. Those officers next to the Castor have to swap positions with others every ten minutes since in this short period of time they will receive their annual legal dose of radiation. Female police officers are not il lowed near the Castor for fear of damage to their progeny

Half a kilometre on, at the crossing first blockade, thousands of protesers watch as straw boles which have been set alight are extinguished with water cannons and pushed aside with bulldozers. Over a thousand people huddle together on the road; the Greens from the Lower Saxony government are also here. People turn their backs on the approaching water cannons and bow their heads.

Rows of police precede the water cannons, duck as they shoot water at the protesters, then run to beat the protesters off the road with truncheons over a metre long.

Panic breaks out, people scream and run away; some are chased and beaten. A Green politician's mouth is stuffed with sand by the police as she cries out for help. 30 people are badly injured; one woman, suffered a fractured skull, though it is not clear if this is the result of a truncheon or a atone thrown by a protester.

From the adjacent fields people have begun throwing stones and bottles at the police. Twenty police officers are slightly injured. Once the road is finally cleared of protesters, the convoy inches forward. The protesters cut across fields to overtake the convoy which is moving at snails pace. Along the road people erect barricades of dead trees pulled out of the adjacent forest, and set straw bales alight. Ahead on the road police prevent tractors from blockading the road. They smash the tractor windows, slash their tyres and break of the valves to let the air out. Fifteen farmers are beaten up; two were taken to the hospital.

It takes over six hours for the convoy to travel the 18 kilometres to Gorleben. In front of the Gorleben intermediate Storage Plant is another blockade of 300 people who are carried away to clear the road which is then cordoned off. We are treated more politely since they know that it will take at least another hour before the Castor arrives. Once they have cleared the road the police stand shoulder to shoulder behind riot shields. Behind them are the dogs.

At 1.07 PM the Castor arrives into the Storage Plant, accompanied by six helicopters circling overhead. Thousands of people stand in the woods and watch as the convoy passes. Some cry, others whistle or hurl abuse, others are too stunned to say anything. The second Castor has made it to Gorleben-at a cost to the state of DM 55 million. It is an expensive business but the government remains firm. It expects the protest to diminish but at the moment this seems unlikely. During the first Castor transport, 3.000 people came out on the streets in protest, and (14,000 police); this year there were over 6,000. Instead of diminishing resistance the shipment has radicalised many people.

Gisela Renolds, Wustraw, Wendland
Peace News June 1966

Russian Repression

Alexander Nikitin is the person responsible for detailing the criminal abuse of the North Sea by the Russian Navy by large scale dumping of nuclear waste. The Russian Government does not deny the truth of what Nikitin says. It just wants to gag him and others like him. He was arrested on February 6 and charged with espionage.

On June 10, 1996 Nikitin was denied bail, and his trial was handed over from a civilian to a military court. Nikitin, a former naval captain, has been held in a St Petersburg jail by the Federal Security Service (FSB - the former KGB). He faces a minimum ten-year sentence, and a maximum penalty of death.

Neither Nikitin nor his lawyer, well-known civil liberties advocate Yury Schmidt, was allowed to attend the June 10 hearing on the case. The hearing took the form of a closed-door submission by an FSB prosecutor to a civilian judge. As a researcher for the Norwegian environmental group the Bellona Foundation, Nikitin helped prepare a report on radioactive contamination of the environment by the Russian Navy's Northern Fleet. Naval authorities allege that Nikitin divulged secret information to Bellona. However, the jailed activist and his supporters insist that all the information contained in the report was freely available from non-classified sources. Bellona's report, which was eventually released on April 19, painted a horrifying picture of neglect by the Northern Fleet of nuclear waste security.

In an interview published by the Moscow daily Izvesliya on June 8, Schmidt charged that the way was being prepared for gross violations of his client's rights. A military trial would "not exclude the possibility of the case being heard in a biased, bureaucratic manner,"

The navy experts who prepared materials for the prosecution did so, Schmidt told Izvestiya, not on the basis of the Russian constitution or the recently-adopted Law on State Secrets, but of "old orders from the Defence Minister which contradict the constitution and the law "

The basis of the charges against Nikitin, Schmidt continued, lay in events from 30 to 35 years back. But the Law on State Secrets stales that the maximum length of time for which material can be classified as secret is 30 years.

Meanwhile, one document cited by the navy experts as containing "top secret information" proved to be an abridged version of an Izvestiya article from March 1995. Bellona activists say that attempts to submit their sources as evidence in the investigation have been refused. In sum, Schmidt told Izvestiya, the only "secret" he had encountered in the case was the passionate wish of the armed forces to hide the catastrophic situation in the area of nuclear safety, compounded by the desire of the FSB to prove its usefulness.

The desperate blundering of the military and security authorities should not, of course lead one to underestimate their seriousness in wanting to rid the country of environmental whistie-blowers.

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Testing, Testing, 4, 3, 2, 1...

The first nuclear test took place at Alamogordo in Nevada US, on Julyl6 1945. The latest on June 8, 1996 conducted by China at Lop Noon In between, at least 2045 nuclear explosions have been carried out by the US, Russia, Great Britain, France, China and India.

As of 1994, the number of tests stood at 2036, of which the US had done 1030, the USSR had done 715, France had done 192, the UK 45 and China 41. Since then, China has continued to test at an increased rate, and France has conducted six tests, bringing the total to approximately 2045 tests. The numbers are in fact a lower bound since although these nations are not ashamed to test they are sometimes reluctant to reveal that they have tested. The 'peak year' for testing was 1962, with 96 US tests and 44 Soviet tests. The largest nuclear test ever was carried out by the Soviet Union in 1961. It was a massive 58megatons, four times the size of the largest US test, of 15Mt.

Besides the official nuclear powers, the Indians have carried out a 'peaceful nuclear explosion' in 1974. A possible nuclear explosion that may have been either South African or Israeli has been detected by spy satellite in the South Atlantic, and the Pakistanis, the Israelis, and the South Africans are known to possess nuclear weapons which they may have not found it necessary to actually test. The Israelis are assumed to possess about 200 warheads, and the Pakistanis an unspecified number, though a French journalist puts it at 15-20, with 80 for India. South Africa has admitted to having 7-8 warheads, which it now says it has completely dismantled.

Recent press reports say however, that as many as 1000 nuclear artillery shells are still possessed by South Africa, and that some of this may have fallen into the hands of white extremists. It is hard to judge just how much of this is true, and the SA government has insisted that it has dismantled all its weapons, but it is possible that some part has not been dismantled as stated

Other 'would be' nuclear powers include Iraq, which conducted an ambitious weapons program that included the development of both plutonium and uranium weapons. Another was North Korea, whose program of gas-graphite reactors coupled with a large reprocessing capability seemed to be tailor-made for plutonium production for weapons purposes. Neither Iraq nor North Korea seem to have quite mastered the arcane art of weapons design however, though it seems likely that they would have done so given the time.

Questions have also been asked about the nuclear intentions of both Argentina and Brazil, both dominated for years by military regimes and neither of whom have signed the NPT. Both countries have ambitious nuclear programs, and both posses secret, unsafe* guarded reprocessing and enrichment facilities. Both however, in recent years, have exhibited some willingness to open up their nuclear programs to mutual inspection and to the IAEA

US Testing

The first ever nuclear explosion by anyone was carried out at the 'trinity' test site in New Mexico from a device suspended from a tower on Julyl6 1945, and was the culmination of the largest secret industrial R&D effort ever, namely the Manhattan Project, involving construction of nuclear reactors, enrichment plants, reprocessing plants and design and research facilities on an unprecedented scale.

Since then, the US has exploded 1,030 weapons and triggers for weapons of a variety of types and range of sizes with the most recent test happening on Sept23 1992, since when an effective moratorium has applied. Of these, 215 tests have been carried out above ground, and 815 underground.

US tests have included 5 underwater tests, 55 bombs dropped from aircraft, 56 exploded from towers, 36 from barges moored in shallow water, 28 on the surface of the ground or sea (which creates the maximum fallout) 40 exploded from balloons or rockets, and up to 1980, 465 exploded underground in shafts or tunnels. Of all these tests, 935 have been carried out in Nevada from 1945-1994, 43 at Eniwetok atoll, 30 at Christmas island, including a number of joint Uk-US tests, 23 at Bikini Atoll, 12 at Johnston Island, 3 in Alaska, and 3 in New Mexico.

The test program started relatively slowly, with three 'tests' in 1945 (two of them on Hiroshima and Nagasaki), two in 1946, none in 1947, 3 in 1948 including the ones at Eniwetok, none in 1949 or 1950, rising to 16 in 1951, 77 in 1958, none in 1959 or 1960 when a brief moratorium was in effect, and a frenzy of 98 atmospheric tests in 1962 just before the signing of the partial test-ban treaty in 1963. The US has also revealed a number of unannounced tests.

Russian Testing

Since 1949, the USSR has conducted 715 nuclear tests (compared to the US's 1030) with the Erst on August29th 1949. and the most recent in October 1990. Of these tests, 508 have been underground, and 207 atmospheric These teats have been conducted either at the Semipalatinsk 'polygon' site, or on the island of Novya Zemlya, in the Russian north, beyond the arctic circle. 496 tests have been carried out in Kazakhstan, 132 at Novaya Zemlya, 2 in the Ukraine, 2 in Uzbekistan, and 1 in Turkmenistan. 81 'peaceful nuclear explosions' have been carried out in Russia, and 26 in Kazakhstan.

Russia has exploded a total of 257megatons in the atmosphere, out of a global total of 438megatons, of which 141 was exploded by the US, and 22 by China.

The first Soviet thermonuclear or fusion device was tested in August 12 1953. a year after the US test of the 'mike' device at Bikini. It was a 'single- stage boosted fission' device (ie a device in which a fission reaction was 'boosted' by a surrounding layer of lithium6 deuteride), with a 200-300kiloton yeild. Later on in 1954, the idea of using radiation compression to compress and ignite a physically separate thermonuclear secondary was arrived at, and such a device was tested in November 1955. The largest thermonuclear device ever was tested by the USSR in 1961 above ground, at Novaya Zemlya. The Soviets also conducted the largest ever underground test, of 3.5megatons. The largest ever US atmospheric explosion was 15 mega tons.

UK Testing

The UK exploded its first nuclear 'device' on Oct3 1952 on an island off the west coast of western Australia. Subsequent UK tests were conducted at Maralinga and Emu Field in the desert of South Australia. Other tests were carried out at Christmas island, first by the UK alone and then in cooperation with the US. Subsequent tests have been carried out at the Nevada test site.

Secrecey and Deception

The public has tolerated nuclearism because it has been kept in ignorance and de/iberately deceived. Every government with a nuclear establishment has persued similar policies. The U.S. government for example, even deceived the public about the very detectability of underground nuclear explosions. In September 1957, after the first underground test in the Nevada flats, the government claimed that the explosion could not be derected beyond 250 miles. The deception was exposed by an investigative journalist who found that seismic stations as far away as Fairbanks, Alaska some 3,000 miles away had detected the shock.

Meanwhile, it has turned out that the UK just like the US, exposed servicemen (mainly Australians) to radiation, and has left plutonium scattered over the Australian desert, necessitating a costly cleanup program for which the Australian government has attempted to bill the UK government, which has refused to pay, causing a considerable ~~wor~~sening in the normally cosy UK-Australian relationship.

The UK chose, with Australian connivance, to test its weapons in the Australian desert because 'nobody lived there. Australian aborigines did in fact both live and hunt there, and a group of them wandered through the fallout area. No attempt was made to warn them of any danger. No record is kept of what happened to them.

The UK has conducted 45 tests to date, of which the most recent have been conducted at the US test site in Nevada. The UK is therefore affected directly by any US testing moratorium, though it has not formally agreed to US announced moratoria. The most recent UK test was on Nov24 1991. The UK, like France until very recently, favours a 100-500Kt 'threshold' for nuclear testing, rather than a zero threshold, a position in which il has been sustained by the US Pentagon.

French Testing

France entered the nuclear race in Febuary 1960, with a series of four above-ground tests in what was then French Algeria.

France was forced to shift its test site to Muroroa and Fangataufa atolls in the South Pacific, when it was found that Algeria was too close for comfort, since shifting winds could bring the fallout over France itself. When the 1963 partial test ban treaty and the 1970 NPT were signed, France refused to sign either, and like China, continued to test above ground • (or above the sea in this case) • at Muroroa and Fangataufa until it was forced by a case bought by Australia and New Zealand to the World Court, to bow to global public opinion in 1975, and take its testing program underground

France has conducted 204 tests to date, of these, about 180 have been in the Pacific at Muroroa and Fangataufa.

France has insisted that its testing program at Muroroa hurts no-one,

and that environmental effects on the coral atoll are minimal or non-existent. However, it has been forced to shift the testing of larger weapons from Muroroa to Fangataufa to limit damage to Muroroa, and there is evidence that considerable damage has in fact been done, both by previous programs of above surface testing, and by the current program of below ground testing.

Atmospheric tests conducted by France from the mid 1960s to 1975 have released most of their radioactivity directly to the atmosphere and the ocean, and have resulted in significant contamination. Hundreds of kilograms of plutonium and fission products have been scattered over the ocean floor. In addition, large quantities of waste have been left: contaminated earth, waste from decontaminating equipment, contaminated clothes, etc.

A map published in Le Monde on Oct 3, 1995 shows severe fracturing of the ocean floor at Muroroa. The French government says the map is "Greenpeace propaganda' and is a forgery."

Scientific missions have been given limited access to Muroroa. Though allowed to take only limited samples, have all detected radioactive iodine, cesium-134, and plutonium, both in the lagoon and outside the 12-mile exclusion zone.

Underground testing involves exploding the device or warhead at the bottom of a borehole about 1000m deep. The explosion vaporizes rock in its immediate vicinity, creating a cavity in which most fission - products are deposited inside the cavity. French authorities claim that they are vitrified in the melted and vuporized rock of the cavity when that cools, and that absolutely none can enter the wider environment. However, extensive Assuring takes place in a radiating pattern from the cavity, and the floor of the atoll is also extensively fissured. Ocean water circulates freely through the fissures.

France has observed a moratorium on testing from 15 July 1991, to September 4th 1995, when the last test series commenced President Chirac said that this series of tests was designed to assure the 'safety' of French warheads, but it looks rather as if the purpose was to finish the development of the TN75 warhead, and to continue the development of other warheads, as well as to develop a simulation capability which would enable warhead development even without testing.

The Sept 7,1995 test at Muroroa, of 20Kt, was for the TN-75 warhead. The TN-75 is a warhead with stealth characteristics, significantly more sophisticated than anything France now has, and is in effect a new warhead.

The last French test was a 120 kiloton blast carried out on Jan27th 1996 at Fangataufa Atholl.

France now says that from 1997, tests will be simulated in the 'laboratory[1], and through computer programs.

The French 'laboratory' consists of an enourmous complex under the control of the CEA's Division des Applications Militaires (DAM), in the south of France. The installation, called CESTA (Centre d' Etudes Scienifiques et Techniqes d' Aquitaine), containes 240 massive lasers of 30Mw each. The laser installation will it seems, have a dual role: the investigation of fusion phenomena for the development of fusion power, and the study of thermonuclear explosions. However, it will not be useful for the study of fission explosions, for which hydronuclear testing facilities and hydrodynamic testing facilities similar to the US's DAHRT facility will be required

Chinese Testing

China conducted its first nuclear test in May 1964, and its 43th test on May 15th 1995, a bare three days after the NPT Review and Extension conference decided to extend the nuclear nonproliferation treaty. Another test was carried out on Aug 17th. The May 15th test was of 40-50Kt, while the Aug17 test was around 60-70Kt. While the Mayl5th Chinese test passed with only pro-forma expressions of regret from the international community, the August 17th test was marked by vigorous protests sparked in part by concern over French testing. The author was the organizer of one such demonstration outside the Chinese consulate in Sydney, Australia.

Of these 44 tests, 23 have been atmospheric, and 21 underground. China conducted the world's last atmospheric test, in 1980.

China had been part of an agreement between the five nuclear powers to exercise 'utmost restraint' in the period leading up to the planned signing of a comprehensive test ban treaty(CTBT) in 1996.

While France and the US have now agreed to back a 'zero threshold' CTBT, which means in effect that no mini-nuclear tests are permitted, China has held out for either a relatively large 'threshold', or for the permitting of 'peaceful nuclear explosions', a formula which seems also to have some following in Russia, too.

Chinese nuclear testing has been carried out at the Lop Nor nuclear test site about 265Km southeast of Urumchi, the capital of Sinkiang. China has carried out a nuclear teat roughly *every* 284 days since it began testing in 1964, and has a nuclear stockpile of abut 450 weapons with a cumulative explosive power of 250megatons. China is

weapon design. In these tests, plutontum or highly enriched uranium is largely or often completely replaced by natural or depleted uranium. But the other components of the device remain unaltered. Implosion and compression take place in the same way and are recorded with high speed X-ray cameras. A series of such tests can help designers perfect symmetrical, stable compression.

4. Experiments in nuclear fusion to develop understanding of the thermonuclear component of weapons as well of the deuterium—tritium boosters that make the fission components of warheads more efficient

5. Computer-simulation or information-site tests. Yield information relevant to weapons design.

6. Theoretical models (other than computer models)

7. There are tests on 'passive' or other components of weapons, which check their integrity and strength, or which examine weapon assemblies to ensure, for example, that they do not detonate when dropped accidentally or hit from one side (one-point safety test).

The last category of tests has nothing to do with the design of new weapons: such tests can at best help maintain existing arsenals. Logically, therefore, they should not be included in the scope of CTBT until dismantling of nuclear weapons arsenals begins. Similarly, there is adequate clarity that the first category, full-fledged nuclear weapon test explosions, must be totally prohibited. What of the rest?

What can be learnt about nuclear weapons design from which type of test?

- yield less than 50 grams of TNT equivalent: Information about one-point safely.
  2 Yield less than 200 grams Information about achievement of criticality.

- 3 Yield under 1.8 kgs: Criticality tests, measurements of temperature and pressure as criticality is achieved an other essential design informtion on the characteristics of the weapon at the very start of the nuclear explosion.

- *4* Yield up to several hundred Kgs Data enabling estimation of the yield of the weapon, and all the other data from the lower yield tests.

- 5 Yield of a few tens of tonnes:Development of advanced weapons consisting of fissile materials only (no thermonuclear component)

- *6* Yield of a few hundred tonnes: Most of the essential data about boosted fission as well as thermonuclear weapons

How Comprehensive!

The nuclear powers have been unwilling to forgo nuclear testing, even in the face of huge financial costs to themselves and opposition from their populations, unless they are able to continue weapons development by other means.

A lively debate has taken place in the weapons establishments of the US, France, and Russia over the extent to which computer simulation and programs of the same sort as the US Science-Based Stockpile Stewardship Program', and the French PALEN program need to be supplemented by 'hydronuclcar' tests of the power of a few Kg of TNT, and *very* small nuclear tests of up to 100 tons of TNT (04 kilotons).

The original position of the different nuclear weapons states: The United States wanted a "comprehensive" teat ban that would permit hydronuclear tests up to 4 pounds; Russia would like to do tests of a few tens of tonnes; France would like several hundred tonnes. China would like a limit of several hundred tonnes if any exceptions are allowed because it feels that lower limits would enable the superpowers to design new weapons more easily than states with less technologically sophisticated equipment.

Ban the Bangs: All the Bangs

The disarmament movement and non-nuclear nations have argued that a test is a test, and that the allowing of 'mini' nuclear tests would enable warhead development to continue, while making enforcement of a test ban more technically problematic. Some nations party to the CTBT negotiations have wanted to ban not only low-yield nuclear tests proper, but also 'hydronuclear' tests and computer simulations.

India has tried to insert a definition of nuclear testing into the CTBT text that includes any release of nuclear energy at any yield however small, produced by fission or fusion bought about by the explosive or other compression of fissile material. This definition covers hydronuclear testing.

Difficulties in Detection

A ban on all testa including low-yield tests and HNEs is not without difficulty! It is easy enough to pick up tests of the type being done at Mururos and Lop Nor of 20-150 kilo tons, and down to about 1 kilo-ton. Smaller tests than 0.1 kilo-ton and very small low-yield' tests would be difficult (though not impossible) to detect via existing seismic methods. Discussions on monitoring arrange-

currently developing two new missile systems, one for deployment in the late 1990s, and one for deployment round 2010, as well as a new sea-launched missile for *use* in a new submarine series. China has also been testing long-range missiles off the north coast of Taiwan.

Chinese weapons are designed at the Ninth academy of the Chinese Academy of Engineering Physics at Mianyang, and plutonium has been produced at two reactors in Gansu and Sichuan. Plutonium production has currently ceased, but a new plutonium production reactor is planned.

The Lop Nor Test Site is in a part of China which is not inhabited by ethnic Chinese, but by Moslem Uighhur people, who would prefer to be independent Much of the fallout from atmospheric testing has in the recent past fallen on the Tibetans, who are also subject to waste disposal and uranium mining. People close to the lop Nor test site have complained of increases in the incidence of cancers and leukemias, and there have been demonstrations against testing. Military authorities have admitted that 'a few deaths'have occurred

China shows no inclination to desist either from weapons testing, or from provocative missile tests, and insists that it has already shown 'utmost restraint' by testing 'only' 43 (now 44) times. One more test, doubtless to come soon, will give it the same testing experience as the UK has. China plans at least three more tests before the year is out

Nuclear Testing and Weapons Design

Over the decades the information provided by nuclear tests has enabled the development of an enormous battery of techniques for the design of nuclear weapons, including theoretical methods and calculation! computer codes, and diverse kinds and sizes of laboratory experiments. While full scale testing of nuclear weapons is the one way in which all the relevant characteristics of a new warhead design can be definitely determined, new weapons can be designed without full scale tests. The degree of confidence in the functioning of a new warhead that has been designed without full-scale tests depends on (i)the range and sophistication of the techniques that are used in the design process, (ii) the complexity of the design, and (iii) the relation of the new design to the designs of warheads that have already been tested.

Nuclear weapons have been suc cess fully designed without full scale tests.In fact, the design of the bomb dropped over Hiroshima was not tested prior to use. That is because the scientists and engineers of the Manhattan Project were *very* confident that the relative simplicity of the "gun-type" design combined with the various theoretical, laboratory and non-nuclear field tests were sufficient to guarantee success. In contrast, they were far less sure of the implosion design that was needed for the plutonium weapon used later on Nagasaki, since the timing of the firing of the conventional explosives that triggered the weapon was so critical.

Types of Tests

There are seven broad categories of techniques that can assist in the design of new warheads without full-scale testing: (By full-scale weapons tests one means the detonation of a nuclear explosive device and the release of large quantities of nuclear energy running into thousands of tons of TNT equivalent.)

1. Nuclear explosions ranging from a few tens of pounds to a few hundred tons of TNT equivalent or less that are not quite full-scale explosions, but which yield most of the crucial information about the functioning of the weapon, other than its exact explosive yield.

2. Hydro Nuclear Explosions (HNEs): These are small scale nuclear explosions which are usually, but not always conducted at test sites, which have low yields, of a few kg of TNT equivalent Hydronuclear explosions are tests which use a limited quantity of plutonium or highly enriched uranium, but do involve a chain reaction. The chain reaction takes place upon detonation, but proceeds far more slowly than in a complete device. The explosion blows the HNE device apart before much energy is released. This stops the chain reaction. The prefix 'hydro' denotes that the core of the HNB device behave like a fluid under compression by a chemical high explosive. Sufficient energy may be released to melt the core, but not enough to heat it to plasma temperatures and make it explode "like a bomb'.

3. Hydrodynamic teats: These study the dynamics of materials (in particular, dummy explosion assemblies) in motion and under compression, but do not involve a release of fission energy. These experiments are typically conducted above ground, in laboratories. These tests by themselves cannot establish the yield of a particular

ments are being vigorously pursued, and it seems likely that an international monitoring system possibly in some association with the IAEA, will be created, incorporating seismic, radio nuclide, hydioaccoustic, and infrasound detection technologies.

The discussions cover rather, the number of monitoring stations, the exact 'mix' of monitoring methods, the point at which inspections might be required, and the relationship between the international monitoring system and national systems (mostly US and Russian spy satellites. They also cover funding and institutional arrangements.

The new positions

President Clinton has announced that he strongly backs a zero threshold CTBT. and has been followed in this by the French who have affirmed that they will not test any more and will rely on the PALEN simulation program to maintain stockpile confidence. In Frances case, the sudden conversion to a Zero threshold CTBT is a result of the intense global pressure they have been under.

The Letter but not the Spirit

In theory, programs such as Frances PALEN program and the US 'Science- Based Stockpile Maintenance' program in combination with sophisticated computer-simulation programs do no more than maintain existing nuclear capacities. Even to maintain existing nuclear capacities however, runs counter the original thinking of a test ban treaty, which was precisely that in the absence of tests, nuclear powers would over the years lose confidence' in their stockpiles. This wasn't a danger to be avoided: It was central to the whole idea!

The danger lies in the very sophisticated nature of the stockpile maintenance programme in especially the US, with a heavy reliance on facilities such as the DARHT facility (Dual-Axis Radiographic Hydrodynamic Test Facility), which performs ultra-high speed x-ray photographs of the high-explosive part of a nuclear explosion, in which the warhead material is compressed by high-explosives into a supercritical configuration, and the NIF facility. NIF is an ultra-power. ful (and ultra-costly) laser device designed to look at nuclear fusion by focusing vast amounts of laser light on tiny tritium/deuterium pellets, providing the necessary conditions for fusion reactions to occur. Concern has been raised that this facility will in fact also duplicate the conditions of a thermonuclear 'secondary', enabling research related to the design of thermonuclear weapons to take place.

While the design of NIF is quite different to that of an H-bomb secondary, the thermonuclear reaction being explored is of course the same. What is of more concern however, is that whatever difficulties there may be in transferring NIF data directly to weapons-related research and new weapons design, NIF will be built in. and its institutional affiliations will be with, the Los Alamos Weapons Research Lab, and it has been widely seen within the lab itself as well as the wider public as a vastly expensive toy to keep one-time weapons designers from boredom. Of the two fecilities NIF and DARHT however, DARHT has no mission apart from weapons design, and it would be possible to design a weapon without NIF, but not without DARHT (or DAHRT's predecessor). Yet concern has been expressed over NIF, while DARHT has attracted almost no attention. DARHT is to be built in two stages, with one X-ray machine being built by 1997 and a second to be added by the year 2000. The two independent axes of observation will enable three-dimensional observation of the compression of materials simulating the pit of a warhead.

Like the US, France also has an ultra-powerful laser facility on the drawing boards, (and in an advanced stage of construction) also nominally for fusion-related research, and like the US, the French facility is under the wing of the CEA's PALEN program. Coupled with a possibly substantial hydronuclear testing program, and ultrs-powerful computer simulation capabilities, it may be possible for at least some weapons development to continue even in the complete absence of actual nuclear tests though weapons designers will always say that nothing beau the thrill of a real nuclear test.

Sources: John Hallam foesydney@oeg,apc.org
Arjun Makhijani: Science for Democratic Actum
'Testing Times' by Praful Bidwai and Achin Vanaik

Six Steps to Nuclear Disarmament

There used to be a time when asking for nuclear disarmament was like asking for the moon. It was an idea confined to a tiny minority that refused to accept that the fears and human suffering of the last 50 years was the most that one could hope *for*. Times have changed. The tiny minority has grown in numbers and gained support from surprising quarters; former nuclear

weapons designers, war planners and even generals have begun to speak out in favour of a nuclear weapons-free world. And for the first time they have a plan based on the experience with the abolition of chemical and biological weapons. In 1952, there was an agree* ment not to use "poisonous gases" and "bacteriological methods" in war. It was a deliberate act of restraint, many countries had these weapons but promised not to use them, and that promise has by and large been kept. From the promise not to use them to banning them altogether, has been a long but not very difficult road. It was long only because it was being travelled for the first time, and the way was uncertain.

Biological weapons were banned by the 1972 Biological Weapons Convention and about 130 countries have signed so far. The convention bans the development, production and stockpiling of dangerous biological materials for any thing other than "peaceful activities. The Chemical Weapons Convention was opened for signatures in 1993 and so far about 160 countries have signed. This is an even stricter convention: it bans the production, development, possession and use of chemical weapons and has created an Organisation for the Prohibition of Chemical Weapons to make sure that no country cheats on its commitments. The precedent is clear. Countries must first agree not to use a particular kind of weapon and then negotiate a convention to ban its development, production and use. This approach can be applied to nuclear weapons. The whole strategy on nuclear deterrence is premised on threat of use which has now been declared illegal by the World Court.

The demand for talks leading to a Nuclear Weapons Convention can be raised *in* the United Nations General Assembly. In its very first resolution in January 1946, the General Assembly unanimously adopted a resolution that nuclear weapons should be abolished. Fifty years is high time that UN begins implementing that first resolution. Only the nuclear weapons powers could possibly be opposed to such a demand, and it is by no means clear that all the nuclear powers would be opposed Those that are opposed would be exposed, isolated and deservedly condemned by the international community.

What is important, however, is for a deadline to be built into the talks on a convention. It should be ready for signature by the year 2000. A date is required and this choice is better than any other. Firstly, a clear deadline, set in advance, will make sure talks don't drag on for years. Secondly, the time is long enough to negotiate a treaty. Thirdly, and most importantly, as interest increasingly focuses on the coming of the 21st century, a Nuclear Weapons Convention could become the right of passage into a newer and better future. As such it could capture the world's attention, and with the whole world watching not even the US would wish to be seen as trying to hold the future hostage.

While these negotiations are going on, those countries that don't have nuclear weapons must create additional nuclear weapons free zones such as those established in South America by the Treaty of Tlatelolco, in the South Pacific by the Treaty of Raratonga and the recently announced African Nuclear Weapons Free Zone. The effect of these treaties is to constrain the movement of nuclear weapons. The aim must be to restrict nuclear weapons to the territory of the countries that actually made them.

The first step towards a world free of nuclear weapons is that the missiles, submarines and planes that carry them need to be withdrawn from active duty, Then nuclear weapons must taken out and decommissioned A disabled warhead is much less dangerous; it cannot go off accidentally, and it is useless to anybody who tries to use it. To make sure that no country tries to hide a few bombs away, everything must be kept under international safeguards. Teams of inspectors, and guards, from many countries will have to work together to keep an eye on each country that has stores of nuclear weapons.

The second step must be to destroy the nuclear capable delivery systems the aeroplanes and missiles that are used to carry the nuclear weapons. Without delivery systems even if a country managed to hide a nuclear weapon or two from the international inspectors, it would have no way of quickly taking them to a target and exploding them.

The third step is for all kinds of tests of nuclear weapons to be banned by a Comprehensive Test Ban Treaty. The first step in such a ban must be to close all the nuclear test sites, this is because testing nuclear weapons is more than just letting off of a nuclear explosion: it is actually a giant scientific experiment, costing millions of dollars, requiring many scientists and large amounts of sophisticated equipment. Closing the test sites will mean that a country wishing to explode a nuclear weapon as a test will have to first prepare a new test site. This can be seen from satellites; it cannot be kept a secret

The ban on tests must also include those conducted in laboratories. Nuclear powers have been testing nuclear weapons for decades. This has allowed them to create computer models they can use to design new kinds of bombs. To make sure that computer Simulations of nuclear weapons is not taking place, all nuclear weapons laboratories will have to be subjected to international monitoring.

Since the objective is a nuclear weapons free world, it only makes sense to get rid of existing nuclear weapons if no new ones are Being made to replace them. Otherwise, old bombs will be replaced with new bombs, and the process will continue. To ensure this requires a stock taking of alt weapons usable radioactive materials: how much material for making nuclear weapons is there already, and where is it. This means that the nuclear facilities in all countries will have to be visited by international teams of inspectors who will undertake this nuclear audit. The report on this audit must be a public international registry of all the radioactive material that can be used to make nuclear weapons. Any country trying to hide nuclear weapons material from the nuclear auditors will not be able to hide more than a small amount. There can be no secret stockpiles of this material that is of any military significance.

Once the amount and location of all the material is known, the factories for making nuclear weapons-and these are factories-can be closed down and all the specialised equipmem dismantled. This is the fifth step. It will make it enormously difficult for any country to ever produce more than a few nuclear weapons, unless it is prepared to get caught and face the international consequences.

To complete the process of abolishtrig nuclear weapons forever the sixth and final step is to ban the military and commercial production and processing of all radioactive materials needed to make nuclear weapons. The ban must include the commercial sector because some of the materials produced by commercial nuclear power stations can be used in the production of nuclear weapons. There is no way of avoiding if any ban is to be permanent. Ending the nuclear weapons age will mean an end to the nuclear age in all its different forms.

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Reviews

Radioactive Heaven and Earth

Plutonium: Deadly Gold of the Nuclear Age

Nuclear Wastelands: A Global Guide to Nuclear Weapons Production and Its Health and Environmental Effects

Nuclear weapons production and testing comes at a considerable real cost in terms of human health and the health of the environment. However, these costs though indisputable are difficult to evaluate because of the following:

1. Governments (all governments of nuclear weapons states and India of the "Peaceful Nuclear Explosion fame) have deliberately withheld whatever information is available from public view. The attempt has always been, irrespective of the ideology of the state to allay public tears rather than to educate so that anyone and everyone can decide tor themselves.

2. The information that is available especially regarding the people at highest risk is seriously flawed. No attempts were made to study the effects of nuclear weapons testing on these people seriously. The people who conducted the tests in all countries were absolutely convinced in the first place that nuclear weapons were essential to security of the country and as a corollary felt justified in subjecting their own populations to risk. The studies that have been conducted on health effects of atmospheric nuclear tests and from venting of underground nuclear tests are grossly inadequate. The estimates of doses that high risk populations have received are serious underestimates made more with a view to decrease compensation claims than with any scientitic objectivity.

3. No serious studies have at all been done on risks to future generations from underground testing. It is well recognised by everybody that storage of long-lived radioactive waste is a risky business. No country in the world has been able to construct a repository for long-lived radioactive nuclear waste despite strenuous effort. And vet unclear weapons powers have been without a care in the world conducting one underground explosion after the other which in effect means pumping long lived radioactive waste into the ground whose rocks have been fractured by repeated explosions.

These and many others detailing the harm done by different processes involved in the production of nuclear weapons are the conclusions of the remarkable series of books published by International Physicians for the Prevention of Nuclear War (IPPNW) in collaboration with Institute for Energy and Environmental Research (IEER). It ought to be noted that the harm done has been mainly to the populations of the nuclear weapons states themselves tor whose security presumably the bombs were being built in the first place, It is a different mutter that all the nuclear weapons powers have so chosen these populatious that they have been unable to protest effectively for long.

The books are very well produced and have extensive documentation. Whatever information is available from different countries has been me ticulously collected and verified. However, a small error which my nit-picking self cannot pass over without comment: The map on page 558 in Nuclear Wastelands showing actual and potential nuclear weapons production and testing sites in India and Pakistan, has left out Kakrapar entirely. Similarly missing are a number of heavy water production facili-

ties whereas some have **been in-**cluded. Although the books are detailed scientifically exacting studies, at the same time they can be profitably read by any interested lay person. To use modern jargon for a book which eschews jargon, they have demystified the subject. Those interested in the subject should contact us or Dr Arjun Makhijani at the address given below. It might be possible to obtain these books free or may be for the cost of shipping.

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Surendra Gadekar

Excuses, Excuses...and a cry for help

Anumukti is a bimonthly publication. A bland statement like this normally implies that an issue is produced every two months. Unfortunately, we have never ever in the last nine years been able to stick to this schedule but at least we were able to bring out six issues every year and you our readers were indulgent enough to allow us this laxity without too much protest.

This year has been a disgrace. From August '95 till now we have been able to produce counting this just three issues. An incensed reader has demanded his money back. Others too have justifiably complained.

What can I say? I have bitten off more than I can chew and this incompetence is the result. In a moment of weakness five years ago, I had agreed to become trustee of Suruchi Shikshan Vasahat Trust. This organisation was started by the pioneering efforts of Shri Mohan Parikh, who believed that an institute imparting training should first and foremost be able to run itself as a successful business and not depend on any donations from altruistic individuals. Suruchi started as a printing press and later as a place for research and extension into alternative energy and agricultural hand tools. In Mohan Parikh's time it did pioneering work which was awarded the Jamnalal Bajaj Award for application of technology to rural areas. Alas, as is true of many institutions, it could not sustain the thrust of its founder and many ills presently beset it. And being a trustee who happens to live not very far away (20 km) it has fallen on me to set things right. This is a herculean effort and I am not up to it. Certainly not up to doing that and managing to bring Anumukti out on time. There are distractions galore. Like an invitation to go to Vienna for the "Ten Years of Chernobyl" (a detailed report in the next issue) Conference, which we combined with a trip to Germany (See Germans say no to nuclear waste on page 5), the Netherlands and the US. Both a holiday as well as a chance to renew contacts and learn afresh about the nuclear issue.

What we now propose to do is to bring out a double issue on Chernobyl next. There is a great deal of accumulated material. Hopefully this would be done quickly enough so that we do catch up a little. However, the real problem is not the present crisis but an absence of helping hands in the long term. Hence, this appeal. We would welcome, nay greatly appreciate any constructive help from anybody who feels committed to either the antinuclear cause or the alternative energy cause.

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Attempting to Fool Some off the People All the Time

A recent news item in 'the Meghalaya Guardian (August 1, 1996) states that "The Uranium Corporation of India Ltd (UCIL) proposes to acquire ten square kilometres of land in the uranium deposit areas of Domiasiat in Hima Langrin of the West Khasi Hills at a compensation of Rs 8 crores." About 30,000 people are likely to be displaced and the UC1L is promising to provide 85 percent of the jobs to locals of the area.

As early as 1954, when Shri Vishnuram Medhi was the Chief Minister of Assam, the government had laid claim to all the minerals in the state including coal and limestone. This proposal had been strongly opposed by the local leadership and in 1958 at the time when Shri B. P. Chaliha was Chief Minister, the government had abandoned its claim. The leader of the opposition Mr. B. B. Lyngdoh feels that the government cannot now displace the tribal population of the area to mine uranium.

The first news regarding the uranium deposit found in the area was in a news item in the Indian Express on the 13th of August 1991. In that it said that the "deposit is the largest, richest, near surface and low cost sandstone type uranium deposit discovered in India so far. The ores are spread over a ten square kilometre area at deposits varying from eight to 47 metres from the surface. Six layers of varying dimensions with grades up to 0.41 per cent of uranium oxide have been delineated by drilling.

The Atomic Mineral Division of the Department of Atomic Energy had discovered uranium in the West Khasi Hills some time before 1991. In the name of prospecting and taking samples they have already taken out vast quantities running into hundreds of tonnes of ore. This was strongly opposed by the local population. Mr. P. P. Lyngdoh, President of the youth wing of the Hill State People's Democratic Party has been active in opposing this 'illegal mining'. Now, the Uranium Corporation of India has decided to 'properly' acquire the land and do legalised destruction.

As part of their efforts to stop this assault on their territory, people had also sent a letter to the Prime Minister. The Department of Atomic Energy had been asked to explain and in its letter of reply had the cheek to say the following:

"The natural radiation level is relatively high around Domiasiat because of the relatively higher concentration of uranium in the area. The higher concentration in the Killing Nale section is related to the fact that the uranium ore-

body is exposed along the banks of the nale, whereas, elsewhere the sediments over the ore-body have helped in reducing the radiation level at the surface. Therefore, the present level of radiation in the area is a natural phenomenon, not induced by the exploration activities of the Atomic Minerals Division and will remain there for thousands of years if the uranium ore-body is not mined. Mining will only help in removing the uranium, which is the source of the radiation."

The letter dated 12/4/95 is signed by Shri B. K. Satra, Joint Secretary (R&D) and has been sent from the Department of Atomic Energy's office in Bombay.

This is a just an example of how the government through its paid scientists tries to fool the people all the time. Doesn't this worthy know that although uranium is the source of radiation, in any ore-body there are many other radionuclides, the so called uranium daughters and although most of the uranium is removed from the site after mining more than 85 pet-cent of the radioactivity remains at the site. And mining of the ore are just means the sediments over the ore body are removed so that il gels exposed. Milling of the ore makes the ore into a powdery form so that radon 222 which is a decay product of uranium in the ore and is itself a radioactive gas gels released to the atmosphere. Free of the confinement placed by nature, these radionuclides some of them with half-lives as long as 80,000 years, cause havoc in the surroundings. The effect of uranium mining all over the world has been to increase the radioactive burden on the people and the environment. To give an impression that mining shall reduce radioactivity in the region is not only fraudulent but stinks of contempt for human rights

Surendra Gadekar.

From *The Editor's Desk*

In our last issue, I had promised that we would be bringing out a special double issue on Chernobyl. However, I find that the amount of new material on Chernobyl is so enormous that to read il and edit it to make an interesting Issue is a task that takes time. So this issue is what is called in the jargon as a quicky. It is something like what the nuclear authorities in India did right at the beginning of the nuclear power generation programme. They had decided to go in for CANDU type reactors since they used natural uranium which was available in India and had on-line refuelling capability which left the much cherished nuclear option in the stale of delightful ambiguity and other reasons as well. However, after finalising the decision to go in for CANDUs, they were offered a deal they could not refuse. General Electric Co. was willing to give a set of its Boiling Water Reactors so cheap that despite the disadvantages of becoming dependent on a foreign source of fuel (since India did not and still does not have enrichment facilities for making the kind of fuel required in these reactors and also the disadvantage of having two different types of reactor systems operating in the country, nucleocrats decided to do a quicky and the Tarapur reactors were built. The fact that dependence on fuel for Tarapur was exploited by the US to bring pressure on India to toe the line is another story.

This quicky issue of Anumukti would not have been possible without the ubiquitous foreign hand behind it. Unlike the help for Tarapur reactors, or other nuclear or even non-nuclear mega projects, which have a client server relationship, this help is mutual co-operation between friends. The *World Information Service for Energy* is a small group of young activists based in Amsterdam who bring out a fortnightly news communique. They act as a worldwide clearing house for information regarding nuclear issues. During a recent visit abroad, we visited them and renewed the bonds of friendship. Most of the stories in this issue have been taken from various WISE news communiques of course with some editiorial comments added.

Energy & Security

Another group with whom we had a very fruitful interchange was lnsitute for Energy and Environmental Research (JEER) in Washington. They bring out a newsletter, *Science for Democratic Action* which demystifies the jargon associated with nuclear enterprise in America and helps grassroots activist groups with technically sound but accessible information. They wish to bring out a global quarterly journal, "*Energy and Security" on* similar lines. This would deal with issues of disarmament, non-proliferation, and sustainable energy lifestyles. The first issue ought to be out within a few days and we. would arrange to send a sample copy to subscribers of Anumukti. If you want to continue receiving the journal (free) please do drop in a line to us in reply.

The Skeletons in the Cupboard Keep Appearing

1958 ACCIDENT AT GREENHAM COMMON

One of the persistent comments often heard about the Chernobyl disaster in Western media has been that the communist government of the Soviet Union tried to hide the truth from its own citizens. This is said with so much contempt that one takes it for granted that the 'freedom loving', democratic governments of the West could never even have contemplated keeping its citizens in the dark. What one finds rather is that these governments because of their veneer of openness managed to hide inconvenient facts not for a mere two days as the Soviet Union managed to do but for well close to thirty years. Truly il has been said that Western democracies manage things better.

The Campaign for. Nuclear Disarmament (CND) has uncovered documents which show that for over 30 years the British and American governments deliberately covered up a serious nuclear accident at the US Air Force base in Greenham Common (UK). The accident, put at risk the lives of hundreds of thousands of US and British service personnel, civilians working on the base, local residents, peace campaigners, police officers and journalists. Local land and animals were contaminated. The radioactive dust from the accident continues to pose a serious threat to the local environment and to the health of local residents in an area renowned for an unexplained cancer cluster.

The accident occurred at 4.25 p.m. on February 28, 1958, when an American B-47 nuclear bomber - loaded with its nuclear weapon caught fire. The aircraft awaiting take-off on the runway was engulfed in a fireball when a wing-tip tank carrying 1,700 gallons of fuel from another B-47 flying overhead was accidentally dropped. The fuel tank landed just 65 feet behind the parked B-47 and directly in line with it, igniting on impact and engulfing the plane. The bomb burned, releasing deadly uranium and plutonium oxide powder over an area of several miles around the base. The conventional explosive in the warhead exploded, helping to scatter very fine uranium and plutonium particles. Because of their high magnesium content both the aircraft and its payload burned extremely vigorously. In fact the aircraft was simply allowed to burn out because it was impossible 10 extinguish the magnesium. The fire was still smouldering five days later, the heat reaching temperalures as high as 1,000 degrees Celsius, explosions could be heard for miles around, and local firemen at first believed that there had been an atomic explosion at the base. A man underneath the aircraft at the time - who may have been involved in the bomb's loading procedure - was burned to death. A number of other service personnel were killed and injured in the accident. A board of officers was appointed to investigate the accident. Its findings are still secret. It is not known what happened to the wreckage of the plane or the bomb.

In May 1960, a group of scientists working at the atomic weapons research establishment (AWRE) at Aldermaston delected, almost by chance, highly radioactive readings near the establishment which could not possibly be explained by its emissions. They used readings taken from laurel leaves, which are highly accurate indicators of uranium contamination, and discovered that the amount of uranium-235 to the west of Aldermaston was one hundred times greater than could be accounted for by AWRE's discharges. When plotted, their readings showed hourglass-shaped contours of radioactive contamination centring around the runway at Greenham Common, which at the time was the base for US Air Force B-47 bombers on constant "Reflex Alert", loaded with nuclear bombs and ready to fly to the Soviet Union at a few minutes' notice. The findings were written up in a secret report called "The distribution of uranium-235 and plutonium-239 around the USAF Greenham Common, Berkshire and submitted in August 1961 to Sir William Penney, the head of the UK Atomic Energy Authority (UKAEA) and one of the architects of the British nuclear lx>mb program. The research team was led by R. Morgan, a radiochemist from Aldermaston. The report carries no AWRE or UKAEA report reference number and is not in any of the standard classified reports series produced by Harwell and Aldermaston. However, the government has recently confirmed the existence of this report and told Parliament that its contents would re-

main secret. The report states clearly that the quantities involved and the wide dispersal are such that "the release must have been accidental. Further, in order to release 10-20 grams of finely dispersed uranium, much larger amounts must **have been involved** in the accident and it **seems the** only possible **way such a large** quantity could **become powdered** is through **the agency** of fire.".

Parts of this report have now been obtained by CND, including a map of the spread of contamination from the accident around West Berks hire and North Hampshire. CND has also obtained secret letters written during the investigation, and has learned about other official government investigations which have confirmed that a nuclear accident did indeed occur at Greenham Common.

As recently as 1994, a fallow-up survey by Aldermaston scantists of the area detected contaminated fall-out from the 1958 accident. A total of between 10-20 grams of uranium was released and dispersed outside the base, yet no clean-up operation has ever been mounted. A much greater amount of plutonium and uranium was certainly deposited inside the base itself on and around the runway - the warhead involved contained about 20 kg of plutonium and 30-*40* kg of enriched uranium - yet the contaminated runway has been crushed and now stands in piles blowing dust over the surrounding area. There is a well-known cancer cluster in the area, and official government studies have confirmed an unusually high incidence of radiation-linked cancer among children living in the area.

The accusing finger has been pointed at the AWRE at Aldermaston and Burghfield, but detailed studies have been unable to find a link between these establishments and cancer among local children. Persistent reports of unusually high and radiation-linked cancers in the area were first revealed in letters to The Lancet, a medical journal, in November 1985 and February 1986, The first letter stated that "since the establishment of a paediatric oncology/haematology clinic at the Royal Berkshire Hospital, Reading, in 1971 we have been concerned that we were seeing more children with acute leukaemia than might be expected in a population the size of our health district's". In 1989, the government appointed its Committee on Medical Aspects of Radiation in the Environment (COMARE) to investigate the claims, and specifically to establish whether there was any link between the cancer clusters and Aldermaston and Burghfield COMARE concluded that there was a "small but statistically significant" increase in the number of cancers that would be expected among young children in the area. However, it was unable to find any link between its findings and emissions from either Aldermaston or Burghfield. Greenham Common was not included in the COMARE study, even though the government knew that the spread of radiation recorded in a 1961 study covered much of the area looked into by COMARE. Other areas covered with contaminated dust by the Greenham Common accident were excluded from the COMARE survey. The Ministry of Defence did not tell COMARE's research team about the accident at Greenham Common, and did not pass to them either the original 1961 report or the 1987 Saxby report. (A study has been written up by W. N. Saxby, a Technical Staff Officer from Aldermaston's Safety Division, and an experienced scientist who had been involved in monitoring fall-out from Britain's atmospheric atomic tests in the South Pacific. Saxby's report confirmed that a nuclear accident had taken place at Greenham Common and found the same hour-glass shaped deposits of contamination around the runway that were found in the first report *of* 1961, The Saxby report is

The 1961 report by Aldermaston's scientists directly disputes the American base commander's statement who denied that the accident involved nuclear weapons. The setentists claims "We suggest that, in fact, a nuclear weapon may have been carried in the aircraft and burned with it," Radioactive debris from the bomb was stuck to Greenham Common's runway by the firefighters' foam. However, the scientists found that the contaminated debris has been repeatedly disturbed by vehicle and aircraft movements and Jet blasts wearing away the runway surface and causing radioactive dust to be blown out of the base into the surrounding countryside. In particular the report warns about the danger of continuing to use the runway because "the high temperature of the air from the jets would cause it to rise, carrying dust and sand particles up with it". The hour-glass)shaped concentrations of radiation materialised because Greenham Common has just one runway with two take-off directions.

It emerged in 1979 that the British and American governments had agreed in 1956 to deny that nuclear weapons were present in any accident involving American nuclear bombers stationed in the UK. The agreement surfaced after details of another crash involving a USAF B-47 - which crashed into a nuclear bomb storage bunker at RAF Lakenheath in 1956 - were revealed by an American newspaper with close links to the US Air Force.

According to a former US Strategic Air Command officer, orders came down to keep "nukes" out of the records. Officially they did not exist.

SOURCE: CND, 162 Holloway Road, London N78dq,Uk

Do *People Want Nuclear* Power? Mo *Way! Saw the Residents* of *Maki in Japan*

A referendum was held on August 4 in Maki town, 25 km Southwest of Nigata City (Nigata Prefecture, mid-north Japan), in which over 60% of the voters said "No!" to the proposed construction of a four-unit nuclear power station in the town. A shocking blow not only to the Tohoku Electric Power Co., but to the central government as well.

Although this referendum does not legally bind the local and national administrations, the mayor of Maki town, Mr. Sasaguchi, had stated before the referendum that the municipal government would respect the result of the poll. In a press conference after the tally of the votes, Mayor Sasaguchi said the town would not sell the disputed piece of land to the electric company. This definitely means that there would be no Maki nuclear power station. Although Tohoku Electric has already 97% of the land it needs to start constructing on public land in question which is centrally located in the intended site.

The plan to build an 825-MW boiling water reactor (BWR) in Maki, which was first proposed in 1969, has been on hold since 1983 precisely because of the great difficulty Tohoku Electric has encountered in buying the necessary land for the site. There were 12,478 votes against the NPS proposal, with only 7,904 in favour. (118 votes were invalid.) Despite the rainy weather, as much as 88.29% of the electorate voted in the poll, showing the strong interest amongst residents on the issue.

This is the very first time in Japan that local residents were directly consulted if they want a nuclear plant in their backyard. The result inevitably affected the national nuclear energy policy.

"I doubt if the voters really understood the necessity and safety of the atomic energy, was the insulting remark of a pro-nuke town councillor, upset by the referendum result. Given the politically conservative background of Maki town, and despite the corrupt practices on the part of the utility (backed up by the Agency of National Resources and Energy), the people clearly expressed their opinion, fulfilling their responsibility to future generations.

Three other towns/cities in Japan enacted N-plant Referendum Act in order to settle siting disputes. But actual polls have been postponed. The Maki result may have significant influence on the political climate in these localities.

The Ministry of International Trade and Industry (MITI) and the subordinate Natural Resources and Energy Agency say the nuclear energy police must continue as it is a national policy in the national interest and must take precedence over local interest. In a bid to promote construction of more nuclear reactors, MITI said on August 23 it would increase subsidies to local governments which host nuclear power plants. "In recent years it has become increasingly difficult to obtain land to build nuclear power plants," a MITI official said. "It is vital to gain local understanding." Annual subsidies to local governments with nuclear power plants are to raised to 80 million yen (US $ 740,000) per one million kilowatts. Under the current system, only economically poor areas receive subsidies of 40 million yen (US $ 370,000) per nuclear reactor, on condition that the reactors have been operating for more than 15 years.

Source: Wise News Comm. 457

The "We Bring Good Things to Life" People Try to Kill Unfavourable News

Not only Indian politicians like to muzzle the press; large multinational corporations so concious of their image are equally inclined. The US power giant General Electric (GE) whose motto is: "We bring good things to life" announced on 28 February 1996 its plan to kill its Advanced Light Water Reactor (ALWR) programme, saying that "extensive evaluations of the market competitiveness of a 600 MWe size ALWR have not established the commercial viability of these designs." GE quickly realised what it had done and tried to limit the damage by saying that the company had **not** intended to suggest that there was no commercial niche for other 600 MW ALWR's and acknowledged that the announcement made it look like GE was "taking a poke at Westinghouse". GE was so concerned about the implications that it offered on 28 February to pay for the cost of Nucleonics Week's pulling back and reprinting of all copies of the February 29 issue of the newsletter, with the phrase reworded so that only 600 MW Boiling Water Reactors of GE design would be implicated by the GE market analyses. *Nucleonics Week* declined the offer.

(Nucleonics Week, March 7,1996)

FRENCH ELECTRICITY EXPORTS

Despite claims of Elcctricite de France (EdF) of making, profits on the export of electricity, the opposite is true. A critical report by the French energy consultancy INESTENE states that EdF should freeze exports of electricity and abandon construction of new nuclear plants. That would be less costly to the country than continuing electricity exports. INESTENE estimates that EdE's export business is losing the company at least Ffr5 billion ($958 million) per year.

Export tariffs are lower than prices for the French industry. Over the past five years, the average export price varied from Ffr0.19 to Ffr0. 227 per kilowatt-hour (KWh) and thus was less than half the average EdF tariff (Ffr0.44). The average electricity export price is also less than the full cost of a French nuclear KWh, which is Ffr0.2275 in 1995 currency. This is a conservative estimate of the nuclear KWh price, because it is lower than a reference price calculated by International Energy Agency (IEA) methods. The cost of exporting electricity also exceeds the revenues received for the exported KWh's. According to the most conservative models of INESTENE, the annual balance of costs for exports show an economic loss of Ffr5 billion. Other less optimistic estimates show a total loss for the country of Ffrl0-35 billion. The emerging conclusion is that exporting electricity can never be profitable in the long term. The report contradicts the belief that given France's overcapacity of 11,000 MW, it is less costly to keep existing power plants working than mothballing them. Freezing the

construction of the four nuclear plants (two at Chooz and two at Civaux), which cost more than Ffr40 billion, saves EdF an expenditure of Ffr3.4 billion.

Furthermore, INESTENE concludes that a "significant part of the exported KWh's must be attributed to fossil fuel sources". In **1994, 40%** of **the** exports to the UK came from fossil fuel plants. The final analysts of the report: "EdF's electricity exports are not profitable either for the economy in general or for the French consumer. The export increases physical and financial risks as well as environmental damage. For the importing countries it is a costly solution for the consumer, a disregard for opinions *of* citizens and trade sector that is secretive and non-responding to market rules." By the way, the French government delayed the publication of another critical report, an IEA study on the French energy sector. The SEA concludes in this report that France is too dependant on nuclear energy.

Source: Power in Europe, 31 May 1996, issue 225, p. 1,2,13

Contact: INESTENE, 5, *me Boot, 75013 Paris. Tel: +33-1-45650808; Fax: +33-1-45897357*

THE RED BOOK IS OUT AND THE BLACKEST ENTREE REFERS TO INDIA

URANIUM 1995: Resources, Production and Demand, Paris 1996, 362 pp. ISBN 92-64-14875-2; Price about US$ 80.

The book is published every other year and contains statistical data on uranium ore deposits and their exploration, uranium production, and reactor-related uranium requirements from 23 of the 25 uranium-producing countries of the world. The most remarkable change, compared to earlier editions of the book, is the inclusion of a paragraph on the environmental aspects of uranium production, in the general introduction, as well as in each national report.

But, the result of this new effort is rather disappointing: Only a few countries give an overview of the environmental impacts of the existing and former uranium mining operations, and how they are going to deal with them. Most countries present only a few rather general considerations, or simply describe, how environmental aspects are considered during the licensing process for new projects. One national report even states "There are no environmental issues related to existing uranium mines" (India), while many others simply omit the topic.

from the Guys Who Gave Us Chernobyl: A Now Offering Coming Soon to a Coast Near You

WORLD'S FIRST FLOATING NUCLEAR PLANT

After years of financial delay, construction of the world's first floating nuclear power plant is underway in Russia. Engineers hope to have it ready to operate by 2001, a prospect that fills environmentalists with horror but has Russia looking south for potential buyers. Russia has long had plans to build a series of small floating nuclear power plants for use in remote regions which are not connected to the national grid, or to replace thermal nuclear power plants that have grown too expensive because of high fuel transportation costs. Andrei Gagarinsky, vice president of the Russian Nuclear Society and head of international relations at the Kurchatov Institute in Moscow, claims: "Russia will need at least 15 small, low-power floating nuclear power plants. They will be used in inaccessible regions of the Far East, extreme North, Altay Territory and the Kola Peninsula." He noted that Russia is the world leader in smalt nuclear power plant production and sees these plants as potential export products, especially to developing countries. He added that Indonesia, South Korea, China, and Vietnam have all expressed interest-

But environmentalists are not convinced. "We know about the quality of the Russian fleet's nuclear reactors. A Komsomolet nuclear submarine is still located at the bottom of the North Sea," says Vladimir Sliviak of the Socio-Ecological Union/Antinuclear Campaign in Moscow. "The Chernobyl explosion blew the reactor lid, a 2,000-ton block of concrete, into the air. These vessels will not even have that sort of protection. This must pose a clear risk to both the marine and land environment."

The floating plant is essentially a ship with two small pressurized water reactors (PWRs) known as KLT-40s, adapted from those used to power Russia's nuclear icebreakers. The KLT-40 enhanced safety PWR, designed by OKBM Experimental Design Bureau of Mechanical Engineering in Nizhny Novgorod, has been used for over 20 years to power the USSR's seven nuclear icebreakers as well as nuclear-powered cargo ships. The reactors each have a power output of 35-50 megawatts, giving the plant an overall capacity of up to 100 MW of power or 50 MW plus power-generating heal. Besides the OKBM, the Kurchatov Institute in Moscow and the Aisberg Design Bureau in St. Petersburg were involved in the design of the plant which is now being built at the Baltisky Shipyard in St. Petersburg.

If everything is going according to plan, the first plant will be sited at the Arctic seaport of Pivek in the Chukotka Peninsula in the far northeast. It will be operated by 40-50 people working in shifts and has a design life of around 40 years. Spent fuel and wastes will be stored on board and every 13 years it will be towed 4,000 kilometers through Arctic seas to Murmansk in the Kola peninsula in Russia's northwest for maintenance and reloading with fresh fuel. During this procedure, which will take around a year, a substitute floating plant will be put in place. The floating reactor is expected to cost $254 million and will take six years to build.

According to Alexander Poloushkin, director general of the Malaya Energetika Research and Production Association: "The plant has reliable protection systems to safeguard against all possible risks, including sinking, capsizing and even an aircraft crashing on top of it," he says. "It won't pollute the area with any nuclear waste because it will be stored on board." (nice try!)

Source and Contact: Vladimir Sliviak, International Nuclear Campaigner, Socio-Ecological Union Campaign, PO Box 211, 121019 Moscow, Russia.

Letter Box

1 visit Mysore city quite often and recently while miking with environmental groups there , I was surprised to know that Government of India has established an industrial unit under the name of Rare Materials Plant which covertly processes nuclear material for both "peaceful" and "defence" needs. I have also been informed that citizens contacting the management regarding the true nature of the plant are given the silent treatment, this makes the existance of the unit all the more suspicious and extremely dangerous to human habitats in the vicinity from a health point of view.

Any information from individuals and groups will be most useful and can be sent directly to me.

C. *Krishnamurthi*
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Armenia in a Bind

No Alternative But Nuclear

Nucleocrats in India have changed their tune. In a spirit of sweet reasonableness they are even willing to admit that nuclear power has not delivered on its past rosy promises. But, they add, despite this miserable past, we have no alternative but to develop it so that its contribution to the nation's electricity supply becomes 15 to 20 percent during the next 20 to 25 years, since the demand for power is skyrocketing and the coal quality is so bad. The following article, describes the devil and the deep blue sea choice facing the people of Armenia, because of an unhesitating acceptance of no alternative but nuclear power hind of thinking.

For six years Armenians lived in the semi-darkness of the Middle Ages. Beginning in 1989, these 3.7 million people in the southern Caucasus survived without adequate heat, transportation, or medical care. There were only endless candlelit evenings with no television or music. "You lived in the Sabbath all year long." a Jewish friend commented.

The crisis was precipitated by a devastating earthquake and the closure of Armenia's only nuclear power plant. It was compounded by the break-up of the Soviet Union and an economic blockade that cut the country off from other energy sources. The power shortage left the post-Soviet government with a stark choice: nuclear power or continued crisis.

For those living through the dark years, the risks associated with nuclear power were overshadowed by the hardship of this period. The reopening of the power plant, which occurred last fall, could never be merely a technical question.

The earthquake of December 7, 1988, measured 6.7 on the Richter scale. It took the lives of 30,000 people, levelled two cities and 55 villages, and destroyed one-tenth of the country's industry. It also shook faith in the safety of Armenia's only nuclear power plant. Medzamor, which sits in an unsafe seismic zone 30 miles south of the capital of Yerevan and 60 miles from where the quack hit.

The plant, which consists of two VVER 440/270 reactors (modified from VVER 440/230s), had one of the best safety records of Soviet-style reactors. Unit 1 came on line in 1976, and Unit 2 in 1980. They provided Armenia with a surplus of energy, which was exported to other parts of the Soviet Union and Turkey.

Even though the plant experienced no damage and was designed to withstand earthquake of up to 8.0, a large movement led by the country's Green Union called for its closure amid safety concerns and anti-Soviet sentiment. Armenia's growing self-determination movement focused on the potentially risky power plant as a symbol of Soviet domination and exploitation.

Alter heated disputes among politicians, scientists, and the Greens, the Supreme Soviet, the highest government body in the then Soviet republic of Armenia, agreed to shut it down. Between January and March 1989, the two reactors went off line. Nearly 40 percent of the country's total energy supply was no longer available.

The break-up of the Soviet Union, following closely on the heels of the plant closure, further destabilised the country. While many problems were common to all former Soviet republics, the era of independence began particularly unfavourably for Armenia, the smallest among the newly independent nations. Since 1989 Armenia has been locked in a bloody dispute with neighbouring Azerbaijan over the territory of the Nagorno-Karabakh, an enclave of Armenia deemed part of Azerbaijan by Josef Stalin in 1922. The ongoing war monopolised the human and financial resources necessary to build an independent post-Soviet infrastructure.

This once scientifically and culturally advanced country also was subjected to a total blockade related to the war by Azerbaijan and Turkey. Armenia's only remaining connection to the outside world was through its northern neighbour, Georgia. But during the fighting, the railway lines and gas pipelines that pass through Georgia were permanently destroyed by Azeris living in that country. Georgia, which did not investigate this terrorism, was believed to be pilfering the Armenian share of gas sent from Turkmenistan. With barricades on all sides, even the delivery of humanitarian aid, now completely dependent on air shipment, was slowed.

Six years

And so the crisis began. Industry slowed, factories shut down, and office workers were laid off. Even ambulance service was halted because of a lack of gasoline. People passed the winters in their apartments, where room temperatures hovered close to freezing. Deprived of their jobs, they had only two reasons to go out-to get fuel and food.

Under the blockade. Armenia could provide for only one-fourth of its daily bread. This brought long and excruciating bread lines, and often the military was required to keep order. Eventually a voucher rationing system was enforced, providing a daily ration of 8.8 ounces per person. " Every day pupils in the school arc fainting," said Hasmik Sargisyan, the director of studies at a secondary school in Yerevan. "The teachers used to keep sandwiches in their bags for emergency cases."

During this period people received only one to two hours of electricity a day, and their lives were defined by it. "We had to manage to do everything in two hours--to cook, to bathe, to wash, to watch TV," said Theresa Arazinan, a professor of musicology at the time was spent planning how to get candles and the fuel to fire wood stoves and kerosene lamps.

Alter the first two years, the government became more efficient in its use of energy and more became available for necessities including hospitals and factories. But people rigged up cable known as "left lines" to siphon off electricity from these high-priority users to augment their two-hours-a-day allowance. Some even attached the left lines to unused metal bed frames, heating them like giant radiators. According to Armenerg, the government's electricity agency, 40 percent of the electricity generated was used illegally. People joked that Armenia's President Levon Ter-Petrosian promised to provide the whole nation with "left lines."

The only outside help with heat came from a U.S. humanitarian program called "Winter Warmth," which provided kerosene to Armenia from 1992. Some people, however, were reluctant to use this fuel, as Armenian doctors warned that the fumes could be harmful to children.

Many people left the country. "I couldn't survive another winter in Armenia. This was sheer hell," said David Babayan, a writer and actor who immigrated to Moscow. According to the U.N. Development Program, 676,000 people-or about one fifth of the population-left during this period, many setting in Russia, the United States, or Israel. Much of the country's professional and artistic elite were part of this exodus. But millions of others remained.

*The **woodcutters***

At first chopping down city trees for fuel was considered shameful, and the main concern of woodcutters was to go unnoticed. At night, armed with axes and saws, they chopped the trees they had targeted during the day.

Very soon it was commonplace and no longer considered a dishonourable deed. The soot billowing from round holes in apartment windows was a sign of success. "I can plant tree in the spring, but I can't bring back my kids," said my neighbour, the father of five children.

People started with the tree in their gardens and ended up with those decorating the House of Parliament. The Ministry of Ecology estimates that 800,000 trees were chopped down throughout the country in the first two winters. After intensive wood cutting the cities seemed bald. "Good bye, and good luck in wood cutting," a television showman would say at the end of the programme. Trees became harder and harder to find. Today there is a memorial in Yerevan, a sculpture of a tree, erected sad a reminder of the "Genocide of Nature."

*Getting **around***

The streets of Yerevan were filled with pedestrians. People walked and drove by instinct, without the aid of street or traffic lights, which were turned on for only two days a year at Christmas time.

Why get into a situation where you are faced with two stark choices:either have the sword of nuclear disaster hanging over you or else freeze in the dark. A non-nuclear sustainable energy future if planned carefully in advance would avoid both pitfalls

The energy shortage also paralysed public transportation. Often trolleys would be stalled on hills when the electricity was cut off. At these times male passengers would get out and push the trolley to the top, and then, like kids on a roller coaster, jump back in to enjoy the ride. When the rare trolley did get electricity, it carried many times more people than it could comfortably hold. And trolley doors never closed as dozens of people hung out of them in acrobatic positions.

Other chose to walk rather than stand in claustrophobic trolleys. With many extra pedestrians came extra falls on icy sidewalks. A common joke in Yerevan was that Armenians had become better at falling than Charlie Chaplin or Buster • Kcaton.

At the zoo

It was a sad day at the Yerevan Zoo when its only elephant, Vova, died in 1993. "The specialists failed to give a precise cause-cold, malnutrition, bad living conditions," said Hripsime Brutian of the zoo's publicity department.

The inhabitants of the zoo were kept in their winter houses, without electricity. "The animals have been in complete darkness for five months and will live [this way] another month until the winter is over," Karo Mandalyan, the zoo's manager, explained. Members of the zoo's staff did what they could. Many brought food from their homes. The snake keeper even took the snakes in their glass containers to his apartment where he could keep them warm with a wood heater. When the elephant died, it was used to feed the other animals.

"Only this winter, we lost *64* big and small animals: zebras, tigers, birds, wolves, and sheep-all from cold and hunger," said the manager. "Every morning I come to the zoo with the fear in my heart to see another dead animal." A visiting journalist filming the zoo for Germany's Stern Television said, "Damm, it was a concentration camp for animals."

A decision

As the energy crisis lingered with no end in sight, the Armenian government announced in April 1993 that it would restart one of the two units at Medzamor as the only viable short-term solution.

Armenian citizens were fully behind the decision, but they were alone in the view. All of the country's neighbours held protests, questioning the safety of the reactor. Turkey, which supported Azerbaijan in its war with Armenia, even offered at one point to lift its blockade if Armenia would keep the reactor off line.

The West also opposed Armenia's decision, and from the start refused to provide technical assistance or guidance for the plant's reactivation, arguing that because the plant was in a zone of high seismic activity, it could never meet safety standards. "We wanted to do all we could to prevent its restart," said a representative of the European Bank for Reconstruction and Development's Nuclear Safety Account (International Herald Tribune, October 25, 1995).

Armenian officials attributed Western objections to their interest in securing contracts for new power plants for Western businesses. "This is a struggle for the market," Vanik Nersisyan, deputy head of Armenia's Department of Atomic Energy, told the International Herald Tribune. "This is an issue of the employment of the Western population." Compared to building new plants, little money could be made in assisting in the upgrade of Medzamor. Armenian plants were not amongst those designated for Western 'help' for 11 other WERs currently operating in Bulgaria and Russia.

Spurned by Western authorities, the Armenian government turned to Russia for help. Russia provided Armenia with loans to upgrade the plant, including the addition of reinforcements against seismic activity and the construction of a new cooling-water lake.

When it became clear that Armenia would go ahead with or without Western assistance, equipment also was provided by France, Germany, Bulgaria, and other European countries. According to the April 6, 1996, New Scientist, some countries were changing their stand on even on the more dangerous RBMK reactors like those at Chernobyl. Again, some interpreted the change as a means of helping Western businesses benefit in the post-Soviet marketplace. "The closure of the reactors would mean that Western nuclear corporations would lose potentially valuable contracts for fitting safety equipment," said German Environment Minister Angela Merkel.

Between 1994 and 1995, more than 500 tons of equipment was airlifted to Medzamor, and 800 upgrades were performed to improve the reactor's safety. After frequently sending World Association of Nuclear Operators and International Atomic Energy Agency (IAEA) inspectors to Medzamor, the IAEA concluded in 1994 that "the plant is safe and there are no principal obstacles for the restart."

Ironically, when Medzamor's Unit 2 was turned on in November 5, 1995, it was greeted with the same euphoria that attended the decision to turn il off in 1989. The plant run at 92 percent capacity during the winter, according to the government's nuclear regulatory agency. It produce enough electricity to satisfy 25 percent of the needs of the country's population and industry.

Armenians are gradually recovering from the dark experience of the past years. They are coming round from the absurdity under which they lived, and getting back to a normal life-or as normal as life can be in the midst of war and a blockade. Today in Armenia we no longer hear children's hoorays when electricity is turned on. It is an accepted part of life, and these cheers are once again reserved for fireworks and Christmas trees

But recovery was built on nuclear energy—a necessary short-term compromise for a country that has no other reliable source of power available.

Source: Bulletin of Atomic Scientists
July/August 1996

Bangladesh Hunts for *Investors for Nuc*lear Power *Plant*

The Bangladeshi government is shortlisting investors willing to fund the Rooppur Nuclear Power Plant. The Bangladesh Atomic 'Energy Commission (BAEC) is considering private firms along with government agencies for the Rooppur plant as the government is now encouraging the private sector to fund such projects. The IAEA is willing to provide consultancy in the installation and operation of the plant. Since years, Bangladesh officials are advocates of nuclear technology and nuclear energy. In 1987, the head of the Bangladesh delegation to the United Nations conference for the promotion of international cooperation in the peaceful uses of nuclear energy, Ataul Karim said: "Bangladesh is convinced that if used in a planned manner with adequate care and caution, the nuclear technology can usher in a new era of progress and prosperity for the developing world ...

Already *in* the mid-sixties, before Bangladesh became independence from Pakistan (December 1971), there were talks of constructing a 125MW nuclear reactor at Itooppur. Suppliers included first USA, then Canada, then the Soviet Union and when that didn't succeed, France. Even Saudi Arabia was (in 1981) said to be willing to finance the whole project. But it didn't work out. Currently, one 3MW research reactor is in operation in Bangladesh. On 14 Sept. 1986, the Triga Mark II (supplied by the US company GA Technologies) became critical at Rooppur.

Sources: Asian Energy News, April 1996/ Statement by Mr. A. H. S. Ataul Karim, March 27, 1987/ Jahrbuch der Atomwirtschaft 1981 / New Scientist (UK), 8 Oct. 1981

Deinococcus Radiodurans Shall Inherit the Earth

IT IS almost supernatural. Deinococcus radiodurans, a nondescript bacterium first isolated in 1956 from a spoiled tin of meat, can survive several thousand times the does of radiation that would kill humans.

This has puzzled biologists for years, as no organism could have been exposed to such intense radiation under natural circumstances. But two bacteriologists in the US have now shown that D. radtodurans's remarkable resistance to radiation is almost certainly a by-product of its approach to surviving dehydration. Meanwhile, other researchers may have worked out how D. radiodurans defies death.

When it comes to withstanding radiation, the five known members of the family Deinocoecaceae have no rivals. Each bacterium carries several copies of its single loop-shaped chromosome. If exposed to between l0 and 15 kilograys of radiation over several hours, each copy sustains around 120 breaks that cut through both strands of its DNA. Other bacteria die if their chromosomes suffer just two or three such breaks, but D. radiodurans can repair its shattered chromosomes. "There's nothing else on Earth that can endure that kind of damage." says John Baton Rouge.

Battista and his colleague Valerie Mattimore realized that D. radiodurans's extraordinary DNA repair system must have evolved to mend DNA torn apart by some other extreme environmental stress. In a paper to be published in the Journal of Bacteriology, the researchers describe how they created mutant D. radiodurans by treating the bacteria with a chemical that 41 of these mutants had lost their ability to withstand radiation, and every one was also unable to survive desiccation. The other mutants, however, recovered after drying out. When the researchers examined the chromosomes of desiccated bacteria, they looked just as if they had been blasted by radiation.

The habitat in which D. radiodurans and its cousins evolved is unknown. They have been isolated from animal faces, Swedish underwear and weathered Antarctic granite. But Battista is sure that, like many free-living bacteria, they must have periodically endured periods of dehydration.

So why have other bacteria not evolved resistance to radiation? Battista says that most survive decision as spores, *in* which their DNA is wrapped *in* protective proteins. "Spores evolved to prevent DNA damage," says Battista. "Deinococcus, on the other hand, has hyped up DNA repair."

After dehydration, the bacterium has to rebuilt a copy of its chromosome from hundreds of fragments. Kenneth Minton and Michael Daly of the Uniformed Services Univer-

sity of the Health Sciences near Washington DC have found that'a key player in the repair job is an enzyme called RecA. This cuts and splices together overlapping fragments of DNA with partially matching sequences, and so can rebuilt a chromosome from random fragments.

In another paper that will appear in the Journal of Bacteriology, Minton and Daly report that deleting the gene for RecA in D. radiodurans destroys its radiation resistance. Replacing it with equivalent gene from a bacterium called Shigella Flexneri did not restore D. radiodurans's ability to repair its DNA. This suggests that D. radiodurans's RecA is usually efficient.

However, D. radiodurans repairs its chromosomes far more quickly than can be explained by the presence of one "souped-up" enzyme. Minton and Daly says that the pieces of radiation-damage chromosome must be held in their correct order to facilitate rapid repair. They treated D. radiodurans cells with a stain that illuminates DNA and found that its DNA is gathered into packets, as it the copies of its chromosome loops arc stacked up. "A lot of these packets look like doughnuts." says Daly.

Minton's and Daly's favoured theory, which they outlined in Science (Vol 270,p 1318), is that the chromosomes are anchored held alongside. These links are known as Holliday junctions. In higher animals, they normally occur during the cell divisions that from sperm and eggs, as an intermediate stage in the "crossing over, mechanism used to shuffle DNA between repaired chromosomes.

Microbiologists want to use bacteria to clean up sites contaminated with chemical and radioactive wastes. It should be possible, says Daly, to take genes that allow bacteria such as Pseudomonas to break down toxic chemicals and insert them into D. radiodurans. The result would be toxin-munching, radiation-resistance superburg.

Peter Aldons New Scientist 9 December 1995

A Technology Full off Unpleasant Surprises

The first meltdown experiment at the Phebus nuclear reactor in Cadarache, France, has come up with unexpected results. Part of the findings of the experiment have been released by the European Community, which funds 30 percent (900 million FF.) of the Phebus project. The full report on the first test is expected to be finished sometime in 1996, but , for commercial reasons, will not be released to the public.

The Phebus experiments consist of six meltdown in the core of the Phebus reactor in the nuclear research centre Cadarache. The goal is to find out whether computer models for meltdown accidents in nuclear reactors are still valid or corrections to these models have to be made.

It took a long time before the first meltdown start on December 2, 1993, as the French nuclear safety authority DSIN worried about a possible steam-fuel cladding reaction. Explosive hydrogen gas is formed in such a reaction, which starts at a temperature of 1200 degree Celsius. Meltdown was finally achieved when the temperature reached 2840$C. The test was interrupted when the fuel threatened to melt through the first barrier. Some days later, a defective safety valve burst, releasing 5 mill Curies of radioactive gas into the air.

One the unexpected results of the first Phebus experiment was that the fuel melted much earlier- It started melting at a power capacity of 50 kilowatt instead of the expected 90 kilowatt. Another unexpected result was that the melting process took place in a bigger core area. The unexpected results gave rise to uncertainties about the project for a time and have led to the postponement of the second meltdown experiment from the original target date of January 1995 to March 1996.

A Dutch physicist involved on the Phebus project believes that the construction of the Phebus reactor itself could be the very reason for the unexpected results. According to him, the meltdown occurred earlier than expected because the transport of heat from the core was too low. He doesn't think that international computer models now often used, like the ones from the Sandia National Laboratories (US), will be changed. "The core could melt two times faster than expected. But WHEN it melts, it doesn't really matter if it goes twice as quickly than expected."

Nuclear power plant owners and others in the nuclear industry fear that the Phebus experiments may provide new insights on meltdown risks which could lead to stronger safety requirements for nuclear plants. Stricter requirements would of course mean more expensive safety measures.

Unlike the first Phebus test, which was conducted with unirradiated fuel; the March 1996 test will be conducted with irradiated fuel, which will come from the closed Belgian BR-3 reactor. The test will be used to gain more insights on the melting of embrittled fuel and the spreading of radioactive materials from it. The project is slated to be completed around 2002, unless new uncertainties arise.

Source: Volkskrant (NL), 3 Febr, 1996; PT Weekblad (NL), 17 Dec. 1993; Standaard (Bel), 4 Dec. 1993.

X-Rays: Unnecessary Overexaminations can Kill

Russia tries to reduce irradiation deaths

One of the good measures which the previous chairman of the Atomic Energy Regulatory Board took was to try and regulate the mushrooming growth of X-ray clinics with no proper equipment, procedures or shielding of technicians and passers-bye alike. However, this is a gigantic task and needs far greater effort than has teen directed at it till now.

Russian citizens are to be issued with "radiation passports" to try to reduce the number of deaths due to overirradiation. In Moscow alone 8000 people die every year of cancer, radiation sickness, or reduced immunity directly related to too many x ray examinations, according to Dr Roman Stavitsky, a senior medical officer who heads a laboratory investigating the subject.

Dr Stavitsky blamed the thousands of dcaths_which include deaths due to diseases related to cancer in subsequent generations_on faulty equipment, outdated attitudes to health care, inadequate training in hospitals and x ray departments, and inadequate shielding from radiation. Russians undergoing routine medical checks are exposed to radiation levels up to three times higher than those used in "civilised countries," he claimed. There are not enough health experts to cope.

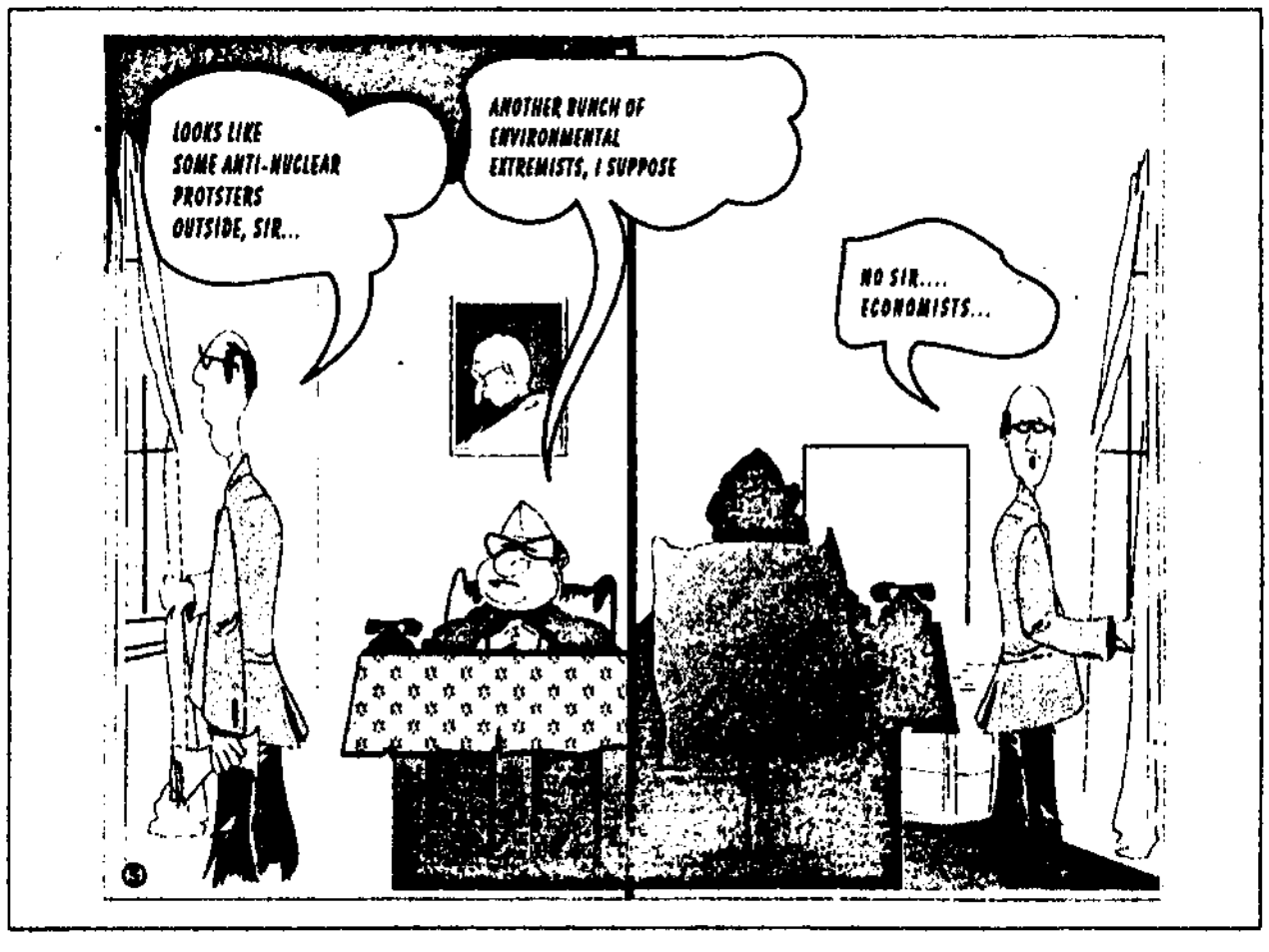
When Russia was part of the Soviet Union all adults had regular lung x ray examinations to screen for tuberculosis. Although this practice was stopped a few years ago, over half of Moscow's adult population had an x ray examination of some kind last year.

Officials in the city health department say that a new health care system introduced in 1992 encourages x ray examinations and that the number of x ray procedures and examinations that are unnecessary has doubled.

Sergei Okhrimenko, deputy head of a city department that checks radiation sources, said, "We consider this a big problem, all the more so since it happens in a country which suffered the Chernobyl catastrophe."

The passports are the brainchild of Moscow's senior radiologist, Yury Varshavskiy who plans to set up a new diagnostic and co-ordinating centre, which would enable people a to keep a check on their exposure to x rays.

Miranda Ingram, Moscow bureau chief, The European British Medical Journal



A Doctor's View of French Polynesia

The land is like our mother. People come from the land.
We must always respect our mother, not explode bombs in her belly
Our good way of life comes from the land.
Destruction of land will lead to destruction of life.

JACQUES IHORAI, president,
Evangelical Church of French Polynesia

"Nuclcar testing ruined the country," says a French doctor. We met on the docks of Tahiti, watching Greenpeace's ship, Rainbow Warrior, depart for the atoll of Mururoa. "Not only by contamination of the environment with nuclear fallout or leakage of the residue in the bottom of the atoll, but far more by disrupting the social harmony of the country," he continues. "The country was self sufficient before the testing started; people subsisted on farming and fishing. Nowadays the state is entirely dependent on France. Imports exceed exports tenfold; il is an artificial state: approximately 15 percent of the population work as civil servants. Migration, loss of cultural values, degradation of agriculture, change in eating habits, prostitution, alcoholism, and mental illnesses are all the result of this. This country is addicted to Prance. Since the moratorium on the testing, the people have been forced to think of a future without France. Resuming the testing is like giving an addict who recently stopped using drugs another shot. France has the obligation to leave behind a state that is self sufficient and not a wreck with a long term legacy of nuclear waste, I can show you files of patients who died of radiation, but I guess you are more interested in public health aspects. Well, the cancer register you might look for doesn't exist: not kept, or hidden, who knows? Anyway, inaccessible for us. Don't forget that until 1984 most practising doctors here were military people. It is no coincidence that the doctor supervising the atolls of Tuamotu, where the test site Mururoa is situated, is still a military doctor."

French Polynesia is an archipelago of about 130 islands, situated in the Pacific halfway between Australia and South America (map). The territory covers an area as big as Europe. Although its population is only 200 000, the country is well known to the world, mostly for its paradise-like scenery. The crew of the Bounty simply refused to sail on and settled on one of the islands. Who has not dreamt of retiring on a distant atoll, inhabited only by some friendly natives, subsisting on fish and coconuts? Jacques Chirac's announcement of the resumption of nuclear testing on the atolls of Mururoa and Fangaiaufa, in the extreme south east of the archipelago, has stirred not only the archipelago but also the world.

As an overseas territory, French Polynesia has an autonomous government, but it depends on France for defence, justice, finances, and foreign affairs. The islands of the archipelago have a volcanic origin. Tahiti, on which half the population lives, is the largest. The smaller islands are atolls; the volcano sank and coral was deposited on top. This coral is visible as a rim above sea level, surrounding the inner lagoon. After Algerian independence forced France to stop nuclear testing there, the French decided that the Pacific was the most suitable place to continue, conducting 44 atmospheric tests up to 1976. Thereafter they performed 110 underground tests, drilling boreholes 800 metres into the basalt of the volcano. It is presumed that the nuclear waste after the blast remains safe in the basalt and does not migrate into the environment. Ironically, Mururoa means place of the great secret in the local language.

A child without an anus

We decided to visit the country to assess the effects of the testing on the health of the population and to see whether this necessitated a humanitarian response. Papeete, the capital, is a small town of about 40 000 inhabitants. It is difficult to keep a low profile. In no time at all the journalists arc alter us. Rumours pop up: we have been sent by the French government; we have boarded the Greenpeace ship Rainbow Warrior to sail to Mururoa. On the street I speak to a woman; she tells me that her child was born without an anus.. "The child was operated in France, but I never got the results of the investigations. They keep the diagnosis secret, they hide the results, sir. There are more children born without an anus," she says. I'm told by another woman that there are 15 000 handicapped people in the country. I try to, calculate a figure for a quick reference; but who defines handicapped? "We can organise for you to meet people who still

suffer from skin diseases, body pains, children with short arms, all due to the testing," a delegate of the local union tells me. I'm not really interested at this stage in a paracie of incurable patients. It seems important to obtain objective data but it is difficult to break through the hysteria of the information.

The high commissioner promises openness; a visit to the site is, however, impossible at this stage, He hopes we understand, He explains some rumours. Radiation is higher in Europe; Australia is nearer to China (which also does nuclear tests) than to Mururoa; and there have never been illegal burials in France. In no time a couple of meetings with local authorities are scheduled. We visit the department of public health and ask directly about the rumours, is the incidence of cancer higher due to the testing? Are evacuations to Paris done secretly? Are there more congenital malformations than in other countries?

The cancer issue would seem easy to answer, but not in Polynesia. "The register started in 1985; before that time no systematic collection of data existed," the official tells us. "But, no problem, if there would be more cancer due to radiation we would find out now, because it has a time lag of decades before cancers develop. Cancer ranks number two on the top five mortality but one should not forget that the population grows older; now the life expectancy at birth is *66* years for men and 72 for women. Furthermore, the lifestyle has changed completely." Indeed the number of obese people in the street is striking. There is no register for congenital malformations in the counlry_difficult to believe for a country in which nearly all women deliver in hospital. If data for the general population are lacking, what about data for the groups at risk: the site workers, in thousands; the military; the people living on nearby atolls who have supposedly been exposed to high nuclear fallout during the atmospheric teste? "The surveillance of the workers is the responsibility of the employer," states the official. Me cannot provide follow up on the issue. "The follow up of the people on the nearby atolls is difficult. There has been considerable migration, how to find the original group? it is too expensive and laborious. We have more pressing issues to address. Road accidents are the number one killer, especially among the youth. In fact we have the highest standardised number of deaths due to accidents in the world. We work hard and we have made progress, but we cannot do everything at once. We have made good progress with health over the last few years."

Indeed, an extensive network of health posts covers all atolls. Most of the atolls are connected by a direct telephone system; if necessary, referrals by plane can be made. The country has 300 doctors and in Papeete there is a referral hospital equipped up to European standards. It seems, however, that the costs of this system are not sustainable without outside help. The contrast of the high level of care and the embryonic stage of data collection for the population at risk is striking and makes one suspicious.

A clinician we speak to later explains that there is serious underreporting of the number of thyroid cancers. "Thyroid cancer is far more common than reported and we definitely see it more than in France. This is not necessarily related to radiation but may be caused by goitre. Goitre has a high prevalence in the area; it already appeared in Gaugin's paintings."

15 000 litres of coconut milk

The next day we visit the nuclear protection and safety institute. "Surveillance is done of the environment and the food chain for the whole of Polynesia," the director explains to us. Later it turns out that they test food everywhere in Polynesia except for the test site. "The test site is not permanently inhabited and no food grows there," we are told. It still seems strange. We are oversaturated with figures. "One has to drink 15 000 litres of coconut milk from Tahiti to get the maximum intake of caesium 137." That seems difficult indeed. "The food with the highest radiation is being imported, Milk powder from Europe, contaminated after the Chernobyl incident, or mineral water with natural radiation yield the highest activity," he continues. The grays, curies, rems, and their modern successors sieverts and becquerels are all within reasonable limits.

Another representative walks in: "1 have worked for over 20 years on the atoll and swum there everyday in the lagoon." We understand that the dose of radiation due to underground testing, as they measure it, is minimal. But has it ever been measured by independent scientists? The three independent studies to investigate the atoll that have been permitted by France have all suffered from the same restrictions: too little time, limited access, and insufficient provision of background data. And what is the long term outcome of the nuclear residue in the bottom of the atoll? It is difficult to imagine what is actually tested; is the hole definitely sealed off, why don't they test even deeper than the 1000 metres they reach now, do they work on the cavity left by the explosion, are all the test holes connected? The answer seems loo simple to be true: "The load is sealed off by the process itself and that is it." The opinion of the officials on the follow up of the workers is also simple: "We have no right to check on people after they quit their job. The environment is surveyed and as long as the radiation is within limits, there is no need to check the people."

The military doctor we spoke to is a nuclear specialist and he too is convinced of the minimal effect of the testing on the environment. "The levels are so low that we have problems with the threshold limits of our detection equipment. No, the environment will not suffer; there are even plans to make a national park of Fangataufa_the abundance of birds is striking." What about the risk of cancer for the workers? "The risk with such a low dose of radiation is not known, but difficult to imagine." he says. What about the follow up of the military? "There are only a dozen military people who received a maximum dose of 15 rem in one incident. Doctors, especially radiologists, obtain the most radiation in Polynesia."

Safe enough for the Cote d'Azur?

Not being able to visit Mururoa, we try to visit a nearby atoll. "Does the boat sail regularly?" we ask a man from Gambler. "Yes," he answers decidedly. "How often?" "Every month." "And returning?" The man looks puzzled by the question, He shrugs: "The next month of course." The journey is abandoned. The rally tour of officials has rendered useful information. The actual radiation from underground testing seems small. But all these figures are provided by the authorities. Why don't the authorities allow in depth research at the atoll by independent scientists? This could effectively counter all the hysteria. Greenpeace never got permission to measure directly around the atoll. Their flagship was blown up by the French secret service in 1985, leaving one crew member dead (and the two secret agents sentenced to jail for 1.0 years). Many Polynesians say "It* the testing is that safe, why don't the French do it at the Cote d'Azur?" Minimal radiation into the environment doesn't exclude all risk. In Chernobyl too the authorities would tell you that the risk was zero. The risk of an accident can never be excluded, In 1985 the load exploded halfway in the shaft at 400 metres; in 1981 a typhoon hit the island, throwing a cement slab, and the nuclear waste that was stored underneath, into the lagoon. The outcome of the nuclear residue in the bottom of the atoll on the long term is unpredictable. Will it not leak and contaminate the environment?

The lack of follow up of the people at risk is a serious omission. 1 cannot state that all tests should be banned_some people argue that the nuclear threat kept the post-war world in a peaceful balance. Minimal ethical standards should, however, be adhered to. Polynesians shoulder a heavy burden of the testing. In 30 years their society changed from a "subsistence paradise" to a money driven society dependent on France. Before, the inhabitants lived on fish; now croissants seem the staple food. This process has brought progress, but has it brought happiness? il is the moral obligation of the French government to pay attention to these aspects and invest in forming a stable society, instead of leaving behind_along with the kilos of radioactive material in the soil_a crippled society. Active follow up of workers and people being exposed to a high level of nuclear fall out at the time of the atmospheric testing seems indicated. This is extremely laborious but not expensive compared with the actual testing. If the French insist on continuing the testing they should take full responsibility for the programme and do everything to protect the local population from the side effects of a show they never asked for.

Source: Hans Veeken, in British Medical Journal (1995) ;311:497-9

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They didn't register us

To Vassily Deomidovich Dubodel, who passed away in August 1988,

and to all past and future victims of Chernobyl

They did not register us and our deaths were not linked to the accident.

No processions laid wreaths, no brass bands melted with grief.

They wrote us off as lingering stress, cunning genetic disorders...

But we are the payment for rapid progress, mere victims of someone else's sated afternoons

it wouldn't have been so annoying for us to die. had we known our death would help to avoid more fatal mistakes and halt replication of reckles deeds!

But thousands of 'competent' functionaries count our souls in percentages, their own honesty souls, long gone

So we suffocate with dispain they wrote us off.

They keep trying to write off our ailing truths with their sanctimonius lies.

But nothing will silence us even after death, from our graves we will appeal to your conscience not to transform the Earth into a Sarcophagus!

A Speci al

Issue on

Lyubov Sirota

ahead! Break some-

Go*ar Thinking*

body's leg. You haven't caused him any harm.
After all, given time the victim can recover, and that according to the nuclear establishment (the International Atomic Energy Agency and the International Council for Radiological Protection), means that he has not suffered any "detriment" and hence he or she should not receive compensation for "bogus" complaints.

In their way of seeing things, any illness or damage done to the individual is not a "detriment" if the individual can recover with time. Thus, liquidators in the Soviet Union who received high radiation doses and whose blood counts are just beginning to become normal after suffering ten years of debilitating damage to the immune system, did not suffer. Similarly all those who suffer non-fatal cancers due to radiation do not have a detriment.

Only "severe" (another value judgement) genetic disease in live-born offspring is a detriment. Embryonic or fetal loss does not count neither do still—births or congenital malformations which are labelled by these worthies as non—severe and non—genetic. Death after the first two weeks of exposure to radiation, cannot be attributed to it. Nor can any death in which the victim did not have a verified acute radiation dose. No cancer can be attributed to radiation unless it has the approved latency period of ten years after exposure. Radiation promoted or accelarated diseases do not count.

Victims produce scientific paper after paper trying to prove the harm caused by radiation and hoping for their "acceptance" by the "recognised" authorities. These agencies just smile and stick to their value judgements. I mink we must begin to ridicule these value judgements rather than strain to keep proving the obvious. It has to be recognised that health effects of radiation are human rights issues They are not just technical or scientific issues.

Rasalie Bertell

From the Editor's

When Will They Ever Learn?

Chernobyl was a disaster, right? It definitely was so for the people. People suffered and are still suffering the consequences of the worst industrial disaster in history. People not only of Ukraine, Belarus and Russia, but even of distant lands where the winds blew and fire rained down. In these times of "free trade" and freer conscience, no place is really safe from the long lasting poisons disgorged by the accident.

But for some folks, the disaster at Chernobyl has been not a disaster but a marvellous opportunity to make more money and continue their power games. These folks are the guys in companies like Siemens, Framatome, GE, Wesunghouse, ABB and the like and their cronies sitting in government ministries all over the world but especially in countries with heavily centralised decision making.

The latest news on Chernobyl is that G7 and the European Union have signed a memorandum of understanding in which they have agreed to pay money to Ukraine to complete two unfinished Russian built reactors in exchange for shutting down the reactors at Chernobyl. Yuri Kostenko has been the Ukrainian minister in charge of the Chernobyl clean up and replacement power negotiations. He is also a candidate to become the director general of the International Atomic Energy Agency. No wonder, he finds nuclear energy as the cheapest and best option for Ukraine. Like some lepers in Indian cities exhibiting their sores to collect money these Ukrainian officials have been trying to extort huge amounts of money (two billion dollars every year for the next 20 years) by playing continuously on Western fears of Chernobyl.

It is indeed a wonder and a sad commentary on our times, that an accident which should have shut down nuclear industry world—wide has instead been used to support its revival, while the victims are left high and dry. What it shows is that how well the nuclear lobby is organised and how it has managed to control the debate Small, isolated antinuclear groups cannot fight this monster adequately. We need to recognise that nuclear industry is a global lobby which requires a global coordinated response.

In this issue we examine the various failures that led to the accident at Chernobyl and also the reaction of the authorities to the disaster and the myriad ways in which the accident was 'managed'. We compare the Chernobyl scenario with the present Indian nuclear scene. This is all the more relevant at a time when Indian political establishment is hoping to become a Santa Claus of the nuclear industry.

Some readers may find difficulty in comprehending the article "The Impossible Nuclear Explosion." It can be skipped on a first reading. We will supply interested readers who write to us the full text along with a glossary which might help in better understanding. However, its conclusions are important: firstly that the explosion at Chernobyl was a nuclear explosion and secondly that no containment in the world could have withstood it. This simple fact, that nuclear energy cannot be made safe by building bigger containment walls, has totally escaped not only the leaders of G7 and their Ukrainian counterparts but even supposedly hard-nosed bankers.

We are extremely sorry for the long delay in the publication of this issue.

5&6

The Reasons Why

In 1989 the Supreme Soviet of the USSR created a special commission to study the reasons of the Chernobyl accident and to examine the actions of authorities after the accident. Included in the commission were about two hundred experienced specialists from different branches of science from the three republics which suffered most from the Chernobyl accident (Belarus, Ukraine, Russia). Deputies of the Supreme Soviet of the USSR from these republics also took part in the activity of the commission. Expert subgroups studied 15 operating reactors of the RBMK' type at Leningrad, Smolensk, Kursk and Chernobyl nuclear power plants. They also collected, analyzed many materials possessed by different organizations and departments of different republics. Ordinarily these materials were not freely available and access to them was denied.

Conclusions of the experts

The primary cause of the accident was violations of rules of nuclear safety in design and construction of the reactor by scientific supervisor and Chief Designer of the station.

The main shortcomings of the reactor RBMK-l000 are:

- high positive void coefficient of reactivity;
- imperfect construction of rods of the reactor emergency system

The emergency situation in the case of the Chernobyl accident was aggravated due to low standards of the regulatory and technical documentation that could not provide adequate understanding to the operators of neutron and physical characteristics of the core of the reactor.

RBMK type reactors were in service since 1973. Several local emergency situations occurred: accident at block 1 of the Leningrad NPP in 1975 during which 14 fuel elements were destroyed; accident at block 1 of the Chernobyl NPP in 1982; failed critical starts of blocks 3 and 4 at the Chernobyl NPP 1981 and 1983 as well as failed critical start of the block 1 at the Ignalinskaya NPP in 1985. Adequate lessons were not learnt from these situations and the shortcomings they highlighted were not corrected.

As can be seen from the above the most serious flaws which led to the disaster were systemic faults. The actions of the operators, (who perhaps because of their thousand years of reactor experience felt that nothing could possibly go wrong) precipitated the already present deficiencies of the system into a disaster However, the immediate reaction of the authorities as well as nucleocrats all oyer the world was to blame the operators.

A Litany of Lies

Lies about Chernobyl started long before Chernobyl became a household word. For a flavour, the following quotation from *Bulletin of the International Atomic Energy- Agency* (Volume 25 Number 2, June 1983)

"The design feature of having more than 1000 individual primary circuits increases the safety of the reactor system-a serious loss of coolant accident is practically impossible." The Safety of nuclear power plants in the Soviet Union is assured by a very wide spectrum of measures, the most important of which are:

- "High quality manufacture and installation of components
- "Checking of components at all stages
- "Development and realisation of ways of localising radioactivity released in case of an accident
- "Realisation of technical and organisational measures to ensure safety at all stages of construction and operation of nuclear power plants"

The accident at Chernobyl on April 26, 1986 demonstrated that all these statements were just plain lies. They had been made by authoritative scientists who were not supposed to be liars, but in their enthusiasm for the technology they got carried away.

A lie repeated often enough and with enough authority becomes the truth. India has no dearth of our own chhota Goebbels. Let us compare the above set of proven lies with what *"Nuclear Power and You"* a Department of Atomic Energy, Government of India publication has to say about the safety of Indian nuclear plants:

"With more than 70 reactor years experience behind us, we can modestly claim that our nuclear power plants offer the greatest possible safety measures on par with the best in the world. This is the result of the state of the art technology employed in design, manufacture and operation of Indian nuclear plants. Reactors are housed in double containment and provided with foolproof triple back-up systems. To guarantee almost no leakage of radioactive elements into the atmosphere."

Reality Check: Before Chernobyl, the Soviets had had more than a thousand years of reactor experience and not a mere seventy.

Finding Scapegoats

Twelve years alter Bhopal we have yet to apportion responsibility and punish anybody for the disaster. But then we are we. What about the Soviets? They did punish people and sentenced them to long prison terms. But this punishment was meted out only to the lowest rung: the operators. Even in the proletarian paradise, higher officials with contacts in the system escaped with light raps on the knuckles. Nuclear *biradari* from all over the world closed ranks under the aegis of International Atomic Energy Agency (IAEA) and helped in perpetuating the myth that the accident was due to the perversity of the operators.

Ready for all eventualities!

"Gennady Aleksandrovich and I have just been at block 4. It's an awful sight. There is a smell of burning and there is graphite lying around. Where does the graphite come from?"

The Minister turned to the director of the nuclear power station. "Bryukhanov, you reported that the radiation situation is normal. What is this graphite?"

"It is hard even to guess The graphite that we got for building the fifth block is all in place, whole. At first I thought that it was this graphite, but it is all in place. We can't therefore exclude an eruption from the reactor." '

"We can't measure radioactivity accurately", Shasharin explained. "We had one radiometer but it was buried somewhere."

"It is outrageous! Why does the station not have the necessary instruments?"

"The accident wasn't in the plan. The unthinkable has happened"

From Grigory Medvedev: Chernobylskaya tetrad 1989

The following is an account presented by Dr. P K Iyengar, ex-chairman Department of Atomic Energy, in a public lecture at Bangalore on October 8, 1990, that is fully four years after the Chernobyl accident and at a time when the above mentioned conclusions should have been known to him:

"The accident was the outcome of an amazingly large number of violations. A technical description of the accident scenario reads like a saga of repeated attempts by the reactor protective system to prevent the accident, each one foiled by the operator. A very brief discussion of the accident, giving only the basic essential parts, is as follows.

"The accident occurred during a test. This test was supposed to be done at a power level of about 800 MW. The RBMK reactor has a positive void coefficient below 600 MW, and so it is not supposed to operate in this range. The operator forgot to enter 'hold power' at 800 MW before power reduction. As a result power fell and went to very low power levels. Frantic attempts were made to prevent this. In the process, more and more control rods were drawn out a many trips were disabled. Finally the reactor was brought up to 200 MW, which is a forbidden zone. The test should not have been attempted in this zone, but the operators went ahead anyway. As part of the test they shut of steam to one of the turbines. This led to a rise in the Primary Heat Transport systems pressure and simultaneously to running down of the pumps connected to that loop. In this highly sensitive region, all these factors combine to give a resultant value for steam quality. In this case, it turned out to be more voidage (bubbles) in the steam. Since the void reactivity coefficient of RBMK is positive, this started introducing positive reactivity, and the reactor went prompt critical (in ordinary language exploded). The proposed test was not a routine test, but a special one attempted in an operating power reactor without proper planing".

Reading this account, one is struck dumb, not so much by the pig-hcadedness of the operators, but by the perversity of the system which allowed such expensive and dangerous plant in the hands of ill-trained and obdurate persons. And the second question that springs to mind is why was the test so important that it had to be conducted in an operating power reactor at the end of its fuel cycle when its inventory of hazardous radionuclides was the greatest?

A familiar Tale

The following account from *"The Legacy of Chernobyl"* by Zhores Medvedev does throw some light on the vexing questions raised above.

According to the Soviet report, Reactor No. 4 at Chernobyl, had begun operating in December 1983. But this is only partly true. The construction of the reactor and all its systems was completed by then and it was launched (made critical in Indian nucleocratic terminology) on 20 December 1983. In the Soviet Union 22 December is a day of celebration for the workers in the energy industry. (This is the day when the profession is given press publicity and awards and bonuses are announced.) There is usually a long .interval between the launch of a new reactor (which runs for a short while on much reduced power) and its full commercial operation. The schedule normally prescribes up to 6 months of tests and repairs. It often takes even longer to test all the systems.

For purely political reasons (which certainly have nothing to do with safety), the administrators, engineers, scientists, workers and operators engaged in running the tests of Unit 4 publicly undertook to reduce the time taken for the tests and to put the reactor into full commercial operation ahead of schedule. Such undertakings arc usually made under pressure from ministerial and Party officials.

Completing a project ahead of schedule is a rare event in Soviet industry and it brings enormous rewards and benefits. The Soviet report to the IAEA acknowledged that turbogenerator tests to use rotation energy had been done - and had failed - at Chernobyl before. The original tests had probably been done during the launching period between 20 December 1983 to March 1984, when they were much safer and when they could easily be repeated. The only way that the time allocated for testing a new reactor can be shortened is by reducing the number of tests and postponing some of them.

Certifying that a nuclear power station is ready to operate is not a single act. Each system most be tested and officially accepted by the administration of nuclear power station from the construction and assembly teams. During the trial of Chernobyl officials in 1987, it was admitted that reactor no. 4 had been cleared for operation, although the safety tests relating to the turbogenerator had failed. The trial was held in camera and the full text of the sentence was not published. But it seems obvious that the acceptance document was signed on the last day of 1983 under pressure, in order to be able to declare that the works planned for 1983 had been fulfilled. In the Soviet system of planning there are annual targets based on a calendar year. If the station head Bryukhanov had not signed the act on 31 December 1983, thousands of workers, engineers and his own superiors in the ministries and committees would have lost bonuses, awards and other extras.

It is now known that the experiment that was attempted on 25 April 1986 was part of the tests which had been left incomplete at the end of 1983 and beginning of 1984. According to the Soviet report on the accident, it had been found (probably in the tests during the launching period in 1984) that the inertia rotation of the turbogenerators was insufficient to provide high voltage current for long enough to fill the gap before the electricity from the diesel generators became available. It seems likely that the engineers responsible for the electrical parts of the project suggested some alterations to the magnetic-field regulator. It would take time to make the alterations but a promise had already been given that the time taken to do the introductory launching tests would be reduced. The people in charge probably made a simple but irresponsible decision -to postpone the tests until the next cycle.

This kind of practice is not unusual in Soviet industrial construction. Many industrial objects are accepted by the relevant government commission with a long list on incomplete elements and operations which the construction team promises to complete after the object has been officially licensed. If the commission takes a strict line and refuses to sign an act of acceptance, no one receives a bonus and basic salaries may be delayed. Everyone, including the government, is unhappy if the plan is registered as unfulfilled. The result is that it has become normal practice to accept as fully operational industrial objects that have not been completed to specification.

Using the inertial rotation of turbine rotors is an important safety device of RBMK systems. The three emergency diesel generators cannot be started instantly. Cold weather probably affects the time it takes to start diesel generators. For the Chernobyl generators, the specifications maintain that they require 15 seconds to switch on and a further 30—40 seconds to produce the en-

A Clear Conscience

"And since we couldn't do anything anyway, we had no problems with our conscience any more. If, for example, we were given an order to dig up the earth from the buildings to the fences: we just moved the fences and that was it Cleaning up just one part seemed like utter nonsense (as did the cleaning up of everything else while the power plant continued to spit out contamination), and so we simply decreased the measures of nonsense and started to fit our days in the categories of the comfort of this nonsense

Source: Tiit Tarlap Chernobyl 1986: Memoirs of an Estonian Cleanup Worker

ergy necessary to run the emergency pumps.

A 50-second gap in the circulation of cooling water through the core might be acceptable if large amounts of fission products have not accumulated in the reactor fuel. But fission products generate residual heat even in the shut down position. The problem is that RBMK-1000 is a system with on-load refuelling. In other words, individual fuel channels can be removed and replaced if necessary without shutting down the whole reactor. And this means that in a mature reactor, there are likely to be both fresh fuel channels and many that are approaching the end of their natural life and have accumulated fission products. The cooling system serves each channel individually. If the water pumps are stopped older fuel channels may overheat and sustain damage very quickly. Thus anything that interrupts the pumping of cooling water through the reactor core is very dangerous. The intention of the engineers to complete the work that should have been done before unit-4 was put into commercial operation and to provide the turbogenerators with an important safety device is perfectly understandable.

Of course. *it*

It is well known that in India—the land of honest politicians and the steel frame officials, such shenanigans as described above are just not possible. Thus, it is a great surprise to recall that when Dr. P K Iyengar himself was about to retire as the Chairman, Department of Atomic Energy, unit-1 of the Kakrapar Atomic Power Station, was commissioned in a hurry despite the fact that the Emergency Core Cooling System failed the mandatory tests before the unit became critical. (See *Anumukti* Volume 5 No. 6 June/July 1992). In fact Mr. K. Natarajan who was the Chief Engineer, (Instrumentation and Control) and a member of the Kakrapar Design Safety Committee had specifically written:

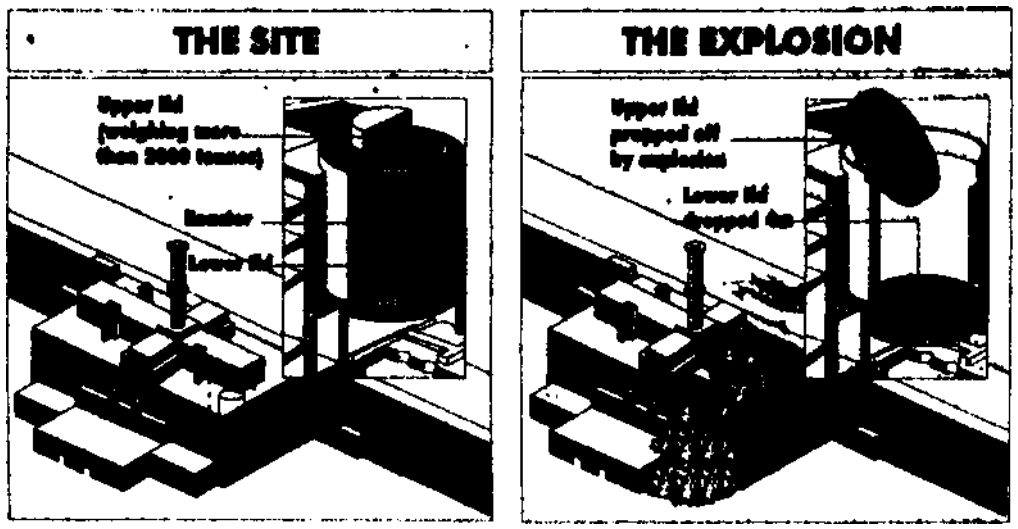
"The tests have been repeated and new operating points set. They are acceptable for KAPP-1 operation. However, a total integrated test with all the subsystems, components and logic functioning, should be done to confirm performance as per design intent in toto. *This must be done in KAPP-2 as soon as the system is ready and any retrofitting found necessary based on this test should be taken up for KAPP-1."*

At the time an annoynimous BARC scientist, who had sent this note to us, had written in his covering letter that:

"ECCS has no back-up system and it is hence essential that the system is fully tested before the reactor goes into operation. The integrated testing of ECCS is practically possible only once during the light water comissioning stage when the Primary heat transport (PHT) system is pressurised and heated up. Once the PHT system is filled with expensive heavy water, the integrated testing of ECCS is not possible since it involves light water injection into the PHT system. It becomes impossible once the reactor goes into operation and makes the PHT system highly radioactive, and misdeeds. This has almost become a culture in DAE." It is believed that actions by few top officials of this department who will be retiring shortly and hence would not be accountable for any future mishap are often responsible for irrational decisions"

After the accident the only people openly held responsible, were local plant officials and engineers. However, the government commission which must have been created to supervise the completion of the project, and which was obliged to check all the necessary tests before signing the licensing documents, must have consisted of competent high officials representing relevant branches of industry, the State Committee on Atomic Energy, the Ministry of Power, the Ministry of Medium Machine Building and officials of the fire protection services, representatives of ministries which manufacture turbogenerators, computer and control systems, representatives of the design bureaux and institutes which designed the project. One section of the commission would be people who had designed and built the project (they would have wanted an early completion date) and the other those who would operate it once it was tested and declared safe (they would normally want as little unfinished and untested work as possible to avoid future problems). If the relationship between the two was purely commercial, it would be impossible to cut too many corners or to cheat. But in the Soviet Union (as in India still) the groups represent different ministries but the same owner - the state. And it is normally state and party officials who try to find a compromise between the two groups. The compromise usually takes the form of an 'act of acceptance' which includes a list of incomplete tasks which the design and construction section promise to complete. All too often, however, the tasks are forgotten by the producers and must be completed by the consumers who were persuaded to accept the incomplete object, this is the rule throughout Soviet industry, from the building of apartment blocks or silage towers to the building of very sophisticated industrial projects.

The *impossible Nuclear Explosion?*



Schematic of the Damage Caused by the Explosion

Nucleocrats all over the world have repeatedly said that nuclear reactors cannot explode like nuclear bombs. This dictum has been repeated so often that even I had started believing in it. After Chernobyl a great deal of effort has been made to convey the impression that the explosion at Chernobyl was a steam explosion and a better Western type containment would have contained the damage. Below we present an analysis by D C Arnott and R D Green that clearly shows that there were two explosions and the second explosion was a nuclear explosion and that no containment in the world could have withstood it. In fact, the authors convincingly argue, that the fact that Chernobyl did not have a strong containment was a help, since the 2000 tonne concrete slab which covered the reactor core at Chernobyl and which was ejected during the first explosion, acted as a safety valve of a pressure cooker and thus prevented far more on-site damage from the second (nuclear) explosion,—Editor

Introduction:

In June 1990 an article appeared in *"Nuclear Technology"* called *"An Analysis of the Physical Causes of the Chernobyl Accident"*. The authors (Jose Martinez-Val et al of Madrid Polytechnic University Institute of Nuclear Fusion) cite results from extensive computer modelling based on the known Soviet data, from which the only conclusion consistent with scientific principles is that the primary cause of the destruction of Unit 4 on 26 April 1986 was a nuclear explosion. This contradicts the report of the British nuclear power establishment, which concluded that it was primarily a steam explosion. The Spanish analysis, drawing upon 46 published studies of the catastrophe, provides important evidence missing from the UK report. Also for the first time it unravels the mystery of why there were two explosions.

The official United Kingdom Atomic Energy Authority report on Chernobyl issued two years after the accident in 1988, was categorical on the point that the explosion at Chernobyl was not a nuclear explosion but a steam explosion.

"In essence, the Chernobyl accident was a steam explosion...triggered by a prompt-critical excursion. Responding to press reports that this amounted to a nuclear explosion, it goes to some lengths to deny such a possibility in any *reactor.*

The Chernobyl (RBMK) Reactor:

It will assist understanding of what follows if we begin with a brief description of the RBMK reactor design (see Fig.). This is additionally necessary because its radical differences from all other power reactors have led to misconceptions.

The core consists of a large assembly of graphite blocks which from the main moderator. This is vertically perforated by nearly 1900 tubes, most of which contain the fuel rods made of enriched Uranium oxide pellets clad in Zircaloy; whilst the remaining tubes contain the control rods.

Water, principally acting as coolant, flows upwards over the fuel rods, generating steam at the top of the core. The steam is fed directly to turbogenerators, after which it is condensed and recycled into the reactor. There is no secondary steam-raising circuit, tinlike the Pressurised Water Reactor (PWR). This defines the RBMK as one type of Boiling Water Reactor (BWR).

The fuel channels, also made of Zircaloy, are pressurised in order that the steam shall be hot enough for effective electricity generation. These channels also provide containment in the event of leakage of radioactivity from fuel cladding failure.

The rest of the core is enclosed in a leak-proof but unpressurised steel shell. Given the design, pressurisation of this shell is unnecessary. This has led to severe but misplaced criticism so important for our theme that it must be spelt out here. The misconception arises because UK thermal reactors are totally enclosed in pressure vessels which (like the RBMK fuel channels) also act as containment. But the pressure itself is not needed for containment: it is employed only because coolant, whether liquid or gas, extracts heat more efficiently when pressurised. However, loss of pressure in water coolant causes

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a phase change from liquid to gas, which drastically reduces its ability to absorb heat. This weakness played a major part in the destruction of Chernobyl Unit 4.

A final point, touching on the most difficult aspect of our analysis, will be helpful. It is that water is not only a coolant, it also absorbs neutrons and acts as a moderator. Loss of water in the RBMK, coupled with retention of the graphite moderator, thus contributed to the Chernobyl disaster.

It is estimated that about 1200 gigajoules of energy were released in Chernobyl eruption. 1200 gigajoules are equivalent to about 0.28 kilotons of TNT. That is more than the 0.25 kiloton yield of some warhead used in battlefield nuclear weapons. Thus the Chernobyl eruption was a tiny fizzle of a nuclear explosion in a device containing the potential fallout from roughly 100 Hiroshima and 100 Nagasaki.

Anatomy of An Eruption:

All accounts agree that about a second after Unit 4 went prompt critical, there were two explosions. The first involved a reactivity burst to about 100 times full power, which the analysis by Jose Martinez-Val et. al. of the Madrid Polytechnic University equates to a release of some 200 gigajoules of energy. Yet the prompt-critical excursion ended only after the second explosion, almost five times more powerful, had ruptured the fuel rods and dispersed enough of them by ejection upwards from the now-exposed core.

There is no dispute over what initiated the first explosion. As part of a mismanaged experiment, four of the eight main coolant pumps were shut down. The rapid fall in pressure caused water in the core to boil vigorously. Steam bubbles absorbed neutrons much less than did the water they displaced: with most control rods withdrawn to try to stabilise reactor power, the increase in neutrons raised reactivity: more steam resulted, and this "positive feedback" process caused a violent reactor runaway was checked only by the inherent Doppler Coefficient effect whereby, as fuel temperature rises, the neutrons available for fission are reduced, and with them reactor power. The Spanish analysis of what happened next:

"A few tenths of a second after the first power burst, the bulk of the energy (initially deposited in the fuel) was transferred to the water in a very fast, non-reversible process very similar to a steam explosion. The heat transmission rate from fuel to the coolant was so high that convective streams could not develop within the water. The steam film and bubbles produced (on) the (fuel cladding) surface grew and expanded much faster than the boiling of the bulk of the water. The internal pressure of the bubbles increased so rapidly that the water was suddenly expelled from the reactor. The 'dried-up' reactor was much more reactive than the wet one, and a second reactivity trip occurred...In any case, this second power burst was stopped only by the destruction of the reactor."

Clear evidence that the core was dry , before the second explosion can be found in Fig. IC following page 5.50 of the United Kingdom Atomic Energy Authority's (AEA) report.

Hence the first explosion occurred with the expulsion of water; while the second, which according to the Spanish analysis released about 1000 gigajoules of energy, was exclusively nuclear.

Attempted Refutation by Nuclear Authorities

The report brought out by UK Atomic Energy Authority (AEA) begins to try to justify its assertion that Chernobyl could not have been a nuclear explosion by describing a nuclear weapon-type explosion: "Weapons designers (achieve a nuclear explosion by) producing rapid increases in reactivity far beyond the 'prompt critical' state..In these circumstances the fission are due to fast neutrons, the time between successive fission is very short and massive amounts of energy are released before the material has time to blow itself apart and thus terminate the fission chain reaction."

It argues: "Such an event cannot happen in a thermal nuclear reactor..." (what is left unsaid is an implication that it can in a Fast Breeder Reactor, to which we will return)"...because the fissile material is mixed with a much larger amount of non-fissile material (Uranium 238) and also because (the) material rapidly disrupts (as it did at Chernobyl)bringing the fission process to an end...long before the reactivity reached the very high levels in an atomic bomb."

It is true that the structure and isotopic composition of the fuel in a thermal reactor differ from those of the fissile material in a weapon. That said, the same prompt neutron from U235 fission cause the chain reaction in a thermal reactor and in a U235 bomb. The difference is that the chain reaction is controlled in a thermal reactor by maintaining a balance between the supply of the neutrons available for fission and their absorption by (he U238 (and also by the water coolant in the RBMK design) or escape from the core. This balance is mainly achieved by a combination of increasing the efficiency of U235 fission through slowing down the prompt neutrons via the moderator (graphite in the RBMK), and adjusting the resulting reactivity level by inserting movable neutron absorbers— called control rods—between the fuel rods.

However, uncontrollably fast power-level changes would occur even for slight reactivity adjustment were it not for the fact that a tiny fraction (less than 1 % of the neutron supply is emitted after a delay of 1/10 seconds. This "delayed neutron fraction"—from fission products— is used by the reactor designer to allow slow enough reactivity changes for human control to be possible.

Radiation

The photo could be of a cornfield anywhere,
but for the two forlorn, elderly gentlemen
with Tolstoy beards standing in the foreground

The taller one to the right holds out
a loaf of a bread on white linen
embroidered with a crewel flower that's upside
down and hung over his unseen hands.
The man on the left is hardly taller than
what appears to be a bumper crop.

He holds a makeshift banner that could belong
to any hippie demo declaring MAKE LOVE
NOT WAR or LIVE AND LET LIVE,
but I can't
decipher the black banner's Belarussian.
The white letters look jumbled and words back
to front, reminding me of what 'live' becomes
when spelt backwards and what's hidden
behind everything these men live f
caught in a cornfield that could be

Greg Delanty

What happened at Chernobyl was that the operators managed to put Unit 4 into a condition where the delayed neutron fraction was swamped by an over-supply of prompt neutrons. This led to an uncontrollable prompt-critical excursion or power surge. All was lost when the water phase-changed to steam (a potentially fatal weakness in water-cooled reactors, as already mentioned). Neutron absorption was reduced, leading to a second prompt-critically. These effects combined to cause what amounted to a very small, inefficient, but entirely nuclear explosion, which only stopped when the core blew itself apart, ending the chain reaction.

The UK nucleocrats buttress their denial of such an eventuality with two more contentions. The report states: "In a power surge, even one in which a 'prompt critical' state is reached, the presence of the Uranium 238 would reduce the increase in reactivity by absorbing more neutrons as they slowed down— the Doppler effect. More Importantly, the majority of fission would be caused by slow neutrons."

Taking its Doppler effect point first, we quoted earlier from the Spanish analysis that the efficient effect would have been overwhelmed in Unit 4. The AEA may in fact agree because, when discussing the accident initiation elsewhere in the same report, it correctly states: "The void effect dominated the Doppler effect and made the power coefficient of the reactor positive.". The AEA thereby rejects its own first contention.

The AEA rates its second contention as more important: "...the majority of fission would be caused by slow neutrons." Here it appears to ignore the fact that "slow" (i.e. moderated) neutrons can cause prompt-criticality. The word "prompt" only indicates a lack of dependence on delayed neutrons. As we have explained, in a prompt-critical excursion any fissioning by delayed neutrons will be swamped by excess of prompt neutrons. Both contentions, therefore, are contradicted by reactor science principles.

The AEA states that such a process would be brought to an end"...long before the reactivity reached the very high levels of an atomic bomb." The Spanish analysis estimates that about 1200 gigajoules of energy were released in the eruption. One kiloton is 4200 gigajoules: so 1200 gigajoules are about 0.28 kilotons. That is more than the 0.25 kiloton yield of the W54 warhead fitted to a variety of US-battlefield nuclear weapons in the early 1960s; while the smallest fission warhead made—for a Special Atomic Demolition Mine—had a yield of 0.01 kilotons.

Of course, 0.28 kilotons is insignificant when compared to even the 13 kiloton yield of the crude and inefficient Hiroshima weapon. But what matters is that no containment could withstand it. This raise another point omitted by the AEA: it is well-known that reactors are much greater sources of contamination than weapons. The Hiroshima bomb contained about 15 kg of U235; while about 5 kg of Pu 239 were used in the Nagasaki device. The core of Unit 4 is estimated to have contained about 1500 kg of U235 and 500 kg of Pu 239 before it erupted, apart from a huge inventory of other very dangerous fission products like Iodine and Caesium. Hence the Chernobyl eruption was a tiny fizzle of a nuclear explosion in a device containing the potential fallout from roughly 100 Hiroshima and 100 Nagasaki.

In sum, the nuclear power establishment admits that an uncontrollable prompt-critical excursion occurred which ended only after dispersal of the fissile material, but tries to divert attention from the fact that this describes a nuclear explosion. It took the Spanish analysis to provide crucial facts (clearly available to the AEA) about the nature of the eruption to establish that Chernobyl was indeed the world's first nuclear explosion in a power reactor.

What was it like on April 26?

We have taken the following from "Inside the Beast" by Sergei Kiselyov from the May/June 1996 issue of Bulletin of Atomic Scientists. For the sake of brevity the article has been edited but we would urge our readers to read the original as well as the other articles in this issue of the Bulletin which is their Chernobyl special.

It is still so much easier to immortalise the names, of those who perished than to provide for the living. There are liquidation workers, inhabitants of the Chernobyl zone, and children who in the past 10 years have been exposed to monstrous levels of radiation. Unfortunately, the government remembers them only on anniversaries.

Most of the men I interviewed have remained silent for 10 years-not because they were scared to talk about what happened at the Chernobyl power station at 1:24 a.m. on April 26, 1986, but they have been more concerned with how to survive and how to provide for their families in these complicated times.

I interviewed many of them in their apartments. I was struck by the fact that their homes were all decorated "Chernobyl style," that is, in a somewhat provincial fashion. More striking still was the fact those who suffered the most from the explosion at the nuclear power station were convinced that it should not be shut down.

Yuri Korneev

Yuri Korneev was assigned to work at Chernobyl immediately after graduating from technical school in 1976. A turbine operator at Unit 4, he was on duty the night of the experiment that caused the accident. Today, Korneev is 39, married, and has two sons. He believes he was exposed to 710 roentgens.

The responsibilities of a turbine operator include making sure the turbine and auxiliary mechanism are functioning properly.

On April 26, precisely at midnight, I started my shift. I knew that an experiment was planned for this night at Unit 4. The seventh turbine was already taken off line, and the eighth turbine, which I operated, was next in line for shutdown and routine maintenance work. The internal energy experiment was supposed to be conducted on this turbine. Many turbine engineers, the chief engineer, and the shop superintendent stayed for the night shift to supervise the experiment.

An hour after I started my shift, the Unit 4 dispatcher informed me that the experiment was starting. I went to control panel, as I had to perform all the steps necessary for the shutdown of the turbine.

Usually, I went through a procedure without any problems. But this time something went wrong. At the moment the turbine stopped working, there was a sudden explosion in the area of the tubing corridor. I saw pieces of the reinforced concrete wall begin to crumble, and the reinforced concrete roof of our Turbine 7 began to fall.

In a few seconds the diesel apparatus kicked in, and emergency lights went on. I immediately looked at the roof of the turbine room. It was crumbing in layers. Falling pieces of concrete were slowly coming closer to my turbine.

It was all unexpected. It was difficult to figure out what was happening. The explosion and crumbling of the roof took only a minute, maybe even less. Right after mat, a shift supervisor, Boris Rogozhin, and the [now] deceased deputy chief engineer ran into the turbine room from the control centre. I was ordered to take care of Turbine 8 and not pay attention to anything else.

I will not go into technical details. Let me just say that I got lucky when, as a result of the explosion, the ceiling slabs fell from the reactor on the top of the seventh turbine room, which was turned off, and not on my Turbine 8.1 was also lucky when, a few minutes after the explosion, a multi-ton lead plug that closed a reactor channel fell within a meter of where I stood.

I was completely in the dark. The senior of turbine management knew nothing. The shift supervisor knew nothing. No one knew anything, and no one knew what had just happened. In the turbine room there was equipment that was supposed to start working when the radiation level increased. However, the level of radiation was so high that this equipment failed immediately.

While I was busy with the turbine, an electrician, Baranov-who later died in the hospital in Moscow-ran in and started pumping out the hydrogen that cooled the turbine generator. His actions prevented another explosion.

After everything, was done, an eerie silence fell on the turbine room. There

In Pripyat, animals crawled, half alive, in terrible pain. Birds looked as if they had crawled out of water unable to fly or walk. Cats with dirty fur, like it had been burnt in places. There were hundreds of dead birds and most of the animals were blind. Most pets, particularly dogs were later killed by special teams of soldiers. Kindness demanded it.

was small balcony; Baranov and I went out for a smoke. Underneath us in the street we saw pieces of Unit 4 and chunks of graphite thrown there by the explosion. Only later we realize what the radiation level was like on the balcony and how many extra roentgens we were exposed to during our smoke.

About two hours after the explosion I started to feel really sick. I had an acute burning sensation in my eyes, and they began to water. I was taken to the emergency room, along with Yuri Vershintn, the inspector on duty, who later died in the Moscow hospital.

On April 27, a bus whose seats and walls were covered with plastic took us to airport. A special flight brought us to Moscow, and the same type of bus picked us up at the Moscow airport.

I was in the hospital until July 14. I didn't have to have a bone marrow transplant, although there were willing donors. I was lucky; my body took care of itself. My diagnosis was radiation illness of the third degree. The highest level of radiation illness is the fourth.

Our locksmith on duty that night, Andrej Tarmazin, is the only man alive diagnosed with the fourth degree of radiation illness. His exposure was 860 roentgens; mine was only 710.

Incidentally, I didn't know this number after the accident; it was concealed from us. I only found out three or four years ago. The Chernobyl fireman who died in Moscow and were buried at the Mitinsk cemetery were exposed to over 2,000 roentgens.

I don't know how and why I survived. The doctors don't know either. In their reports they write that I do not have health complaints. They are right; I don't have any. The only thing is, I have two artificial lenses in my eyes, and my wife, on the other hand, is not feeling that. well. My younger son has stomach problems, the older one, heart trouble.

I haven't worked anywhere after Chernobyl.

Those who were at the station on the night of the accident get a lot of help from the current management of the Chernobyl power station. They have given us the extra money the government cheated us out of for the past 10 years. My pension today is about $250 a month. It's better than it was before.

Who is to blame for the accident? The operators were blamed for everything, and they still haven't been exonerated. But blame can be assigned [elsewhere}. The blame falls on those who built the station quickly, and those who claimed to have finished each unit before the deadline, communist-style. Blame probably also fall on those who organised the experiment on April 26, 1986. We received no instruction on that day, so cocksure were they that the atomic power station was safe and secure as an electric kettle. Nobody even thought it could explode. The people who were on duty that night, what did they do wrong?

During my visit to Pripyat I saw soldiers and officers picking up graphite with their hands. They had buckets and were collecting it by hand. They poured it into containers. There was graphite lying around everywhere, even behind the fence next to our car. I opened the door and pushed the radiometer almost onto a graphite block. Two thousand roentgens an hour. I closed the door. There was smell of ozone, of burning, of dust and of something else. Perhaps this was what burnt human flesh smelt like. Having filled their buckets, the soldiers seemed to walk very slowly to the metal containers where they poured out the contents. You poor dears, I thought, what an awful harvest you are gathering The faces of soldiers and officers were dark brown: nuclear tan. The weather forecasters promised heavy rain, and to prevent the activity being washed into the soil by the rain, people were being sent instead of robots, because there were no robots.

Grigory Medvedev

Nikolai Gorbachenko

work at the time of accident. He had worked at Chernobyl since 1976. Now 42, he is married and has two children and a three-year-old grandson. He believes he was exposed to 300 roentgens.

Radiation monitors at the atomic power stations are like scouts during wars; they come in first and leave last. The radiation monitor measures radiation levels in the workplace before the workers come in. After the shift is over, he measures radiation levels again.

My shift began at midnight on April 26. I had to take measurements in the reactor rooms of Unit 3 and 4, and check the data units. I checked Unit 3; but on my way to Unit 41 remembered it was in the process of being shut down, so I decided there was nothing for me to do there. I was really lucky that O wasn't at the reactor when it exploded.

I returned to my duty room to have some tea. Then we heard a flat and

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powerful thud. My colleague and decided the turbine operators had produced a hydraulic hit, which sometimes happens during the shutdown of a turbine. At that moment we heard another flat thud. The lights went out; the light on the control panel of Unit 4 went out as well. Just as in a horror film, the blast blew out the double doors that had been latched. Black-red dust started coming out of the Ventilation vent. In a few seconds, the emergency lights went on. We put on our gas masks and tried to make a call, but the phone wasn't working.

We had dosimeters that measured up to 3.6 roentgens per hour. They immediately went off scale. My boss sent me to Unit 4 to find out what the radiation situation was like there. I went to the turbine room and walked around. It was pitch black, but I had a powerful flashlight. There were pieces of concrete everywhere. With my low-power dosimeter, I wasn't able to measure the radiation level. I returned to my post and told my supervisors what I'd seen.

Then two guys walked in. They said: "Hey. buddies, help us find a comrade of ours, Vladimir Shoshunok. He's been gone for 30 minutes and we haven't heard from him. He's supposed to be on the upper landing across from the turbine room."

So I went the two men to look for their comrade. In the darkness we made our way through piles of rubble, and went up to the landing. Everything was in shamble, steam was coming out in bursts, and we were up to our ankles in water. We made our way to the structure where the man we were looking for was supposed to be. We went inside and saw there was nothing-concrete slabs of the outside wall had been thrown to the street by the force of the explosion. It was night-darkness and dust everywhere. It was impossible to see anything. Even when you shone a light, the ray just vanished somewhere. We began to call to Valodya.

Suddenly we saw him lying unconscious on his side, with bloody foam coming out of his mouth making bubbling sounds. We picked him up by the armpits and carried him down. At the spot on my back where his right hand rested I received a radiation burn. He died at 6:00 a.m. in the Chernobyl hospital, never having regained consciousness. The two guys who looked for him with me later died in a Moscow hospital."

When I returned to my post, I put on dry clothes and changed shoes. As a radiation monitor, I understood what was happening and the fate that awaited everyone who was at the station that night. Then we received an order to look for; Valery Khodymchuk. Our search was unsuccessful. As we later learned, he died in the explosion.

At 5:00 a.m, I started to feel terribly weak and nauseous. I was taken to the hospital. A friend of mine, who worked in the emergency room, saw me in the waiting room. He took me aside, gave me 500 grams of pure alcohol, and told me to drink that.! drank it and washed it down with water. Then I called my wife and told her I was OK. Later on, the doctors told me that the alcohol, which I drank on an empty stomach, helped me a lot.

On April 26 there were already doctors from Moscow in the hospital. Seven or eight of the most difficult cases were flown to a Moscow hospital on the same day. They all died in that hospital. The rest went to Moscow on the following day. I was in the hospital for six months, from April 27 to October 27. It wasn't a pleasant sensation. You go to sleep at night not knowing whether you will wake up in the morning. Many died-often those who seemed to be getting better.

When I returned to Kiev in the fall of 1986, I received the lowest possible disability rating. I was given an apartment here, although I was also offered one in Moscow. I regret I didn't stay there. The Chernobyl workers who moved to Moscow receive a much better pension than we do in Ukraine.

I worked until 1991. Then it became too difficult and I retired. Although my disability rating was increased, my pension is small. My wife also doesn't work; she is sick. My children aren't doing well cither. Their blood tests are bad and they have constant headache. 1 check into the hospital twice a year for a battery of tests.

Yuri Andreev

In April 1986, Yuri Andreev was a senior engineer at Unit 2 at Chernobyl. He had worked at the Krasnoyarsk and Smolensk power station before moving to Pripyat in 1982. Since 1991, he has served as president of the Chernobyl Union of Ukraine, an advocacy organization for the thousands of Ukrainians who participated in the clean-up after the accident. Andreev is married, with two daughters. He believes he was exposed to 150 roentgens.

At the midnight on April 25, 1986, my shift ended. I left before Unit 4 exploded. I spent the night of the 25th-26 at home, and didn't hear the explosion. At 9:00 in the morning, my wife returned from the market and said there were rumours in town that there had been an explosion at the station. I told her I didn't believe it, and I took my daughter out far a walk. I saw the streets of our town Pripyat-with 55,000 inhabitants-bein

washed with a sudsy solution. There were also many police on the streets, and they were armed with automatic weapons. Although there were no signs

of panic, everywhere beer and *Kvas* [a fermented low-alcohol drink] where being sold from the tap.

After I saw all of this, I decided to walk to edge of town, where I could see the power station, which is located two kilometers outside of Pripyat. I saw that there was only a wall left of the central building of the station, the one around the reactor. There was no roof, grey smoke was rising above the ruins. I understood immediately that reactor fuel was exposed to the atmosphere.

On the way home I noticed that there were a number of armoured vehicles from army chemical intelligence, and soldiers with dosimeters. I asked one of the officers what the radiation level was. In response, he hastily blocked the scale from view and told me to mind own business. One emergency vehicle after another headed from the power station to the city hospital.

On my return home, I didn't want to frighten my family, but I told them not to go out for any reason, and to wrap the shoes they had walked in today in wet rags and put them outside, and to conduct a through wet cleaning of the apartment.

My shift at the power station began at 4:00 p.m. [On the way to the station], the bus took a different route; it went on a detour past the cooling pond and the ruins of Unit 4.

I realized that what I had seen from town was nothing. I couldn't have imagined that something like this would ever happen. I saw parts of the reactor a person should see only once in his life-before the reactor goes on line. On the ground were pieces of the roof, thrown there by the force of the explosion, as well as drums from the separators, pieces of tanks from the emergency cooling system, and many other parts. It was obvious that the reactor was exposed to the atmosphere and "breathing." Toward evening you could see an even, dark purple glow above the active zone.

Our shift began with an order to shut down Unit 2. Everything started well, but then there was a glitch. During shutdown, the fourth turbine suddenly went off. Lights went out on the reactor's control panel. The alarm sounded. In a second the emergency light kicked in. But in this fraction of a second, I felt fully my helplessness before the nuclear machine. I felt with sudden intensity what my colleagues had gone through the night before, when they couldn't control Unit 4.

However, the shutdown of Unit 2 was successful, as well as the shutdown of Unit 1. [Unit 3 had been shutdown early in the day.]

The next day, April 27; the evacuation of Pripyat

Col. *Anatoli Kushnin*

Col. Anatoli Kushnin, chief of the chemical defence air force division. Kiev military district, served in the Chernobyl zone from April 26 to May 22, 1986. A member of the army since 1968, Kushnin graduated from the military Academy of Chemical Defence in Moscow in 1977. At the time of the Chernobyl accident, he was chief of the air force's chemical defence unit charge of Ukraine's Radiochemical and Biological Defence force. Now 46, he is married and has two daughters. He believes he was exposed to 130 roentgens.

Certainly Heroic, But Was It Worthwhile?

Colonel Nesterov, was the first to fly a helicopter on a 'bombing run'. He flew over the crator of the nuclear reactor. At 110 metres over the crator the radiometer registered 500 roentgen per hour. He could feel the heat from below. A mighty torrent of radioactive gas, ionized by neutrons and gamma rays, rose up. All this without respirators. The helicopter was not protected underneath with lead. They stuck their heads out through the open door to aim at the nuclear crater and threw the sacks. The first twenty seven crews soon had to be sent to Kiev for treatment. The pilots began to find it hard to breathe. Throwing sacks had a significant effect on the active zone. The amount of radioactive dust emitted rose sharply particularly on the first day. People breathed all this. For a month afterwards uranium salts and plutonium were washed from the blood of these heroes. On subsequent days the pilots themselves began to put lead sheets under their seats and to put on respirators.

residents began. My wife and children went to the Zhitomir region, where my wife's parents lived. I remained at the power station, as did all the station personnel. At first we were taken our shifts by bus, as before. Thus, during one round trip to work, we were exposed to 5 roentgens, the maximum considered safe as an annual does. Later we were taken to work in armoured vehicles. For a while after the accident, the station cafeteria was closed; all the stores in Pripyat were also closed. The town looked abandoned and frightening.

We were left to survive with an order to hold the station together. J didn't sec any outside help. We had no dosimetric devices; the once at our disposal didn't work. The most popular books for us at this time were whatever textbooks on haematology and civil defence we could find in the libraries. At least they provided some information on radiation and its doses.

I continued working at the Chernobyl power station until 1988. Then began having problems with my health. I fainted at my work station several times. Incidentally, to maintain secrecy all the medical histories from 1986 were destroyed in 1989. Station personnel received new medical histories that no longer contained the results of their 1986 blood tests or their diagnoses.

I found out about the Chernobyl accident on the morning of April 26, 1986, when I came on duty. The duty officer told me about the accident and fire at the Chernobyl power station.

First. I tried to find out what the situation was like at the station. I called the headquarters of the army's chemical defence forces for Kiev military region. The senior officer there informed me that the radiation situation was bad as a result of an accident, but that there was no precise data available.

In the meantime, the headquarters of the Kiev military region ordered an immediate transfer of pilots from Kirovogradsky region to the air field closest to Chernobyl . At 11:30 p.m. the regional air force commander, Major-Gen. Nikolai Antoshkin, and I drove to Chernobyl. We approached the power station by 2:30 a.m. A red glow was over it. We passed the station and went to the town of Pripyat. The liquidation [cleanup] headquarters were located at the city hall.

We immediately got to work. In order to put out the reactor fire, the decision was made to dump sand over it from above. It was necessary to form teams to fill sacks with sand, which we later dropped into the reactor core. Then we dropped lead into the reactor. There was a supply of boric acid at the station. We also dropped boric acid. Since the rods used in stopping a nuclear chain reaction are made of pure boron, boric acid could help to retard the reaction as well.

All this work fell on military pilots. At the time, there were 80 helicopters and air-planes of various types deployed in Chernobyl. Every officer in our on-the-ground provision group was responsible for various aspects of this job. At the head of the chemical service, I was responsible for radiation safety on the staff, for preventing military personnel from being overexpose, and for recommending appropriate safety measures. For example, I told the helicopter pilots to cover the floor of their machine with sheets of lead.

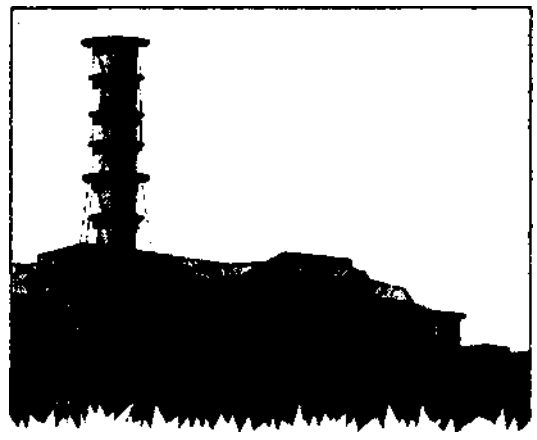
I was in Pripyat. The helicopter strip was located 11 kilometers from the reactor. I used a deserted military airstrip midway between these two points as a decontamination station for helicopters and pilots. Special technology was sent there. After flying above the reactor, helicopters were washed with special solutions and their crews showered and received new uniforms and shoes. The helicopters were returned to their base practically clean. Those machines that couldn't be cleaned remained within the 30-kilometre zone. We left helicopter engine, which couldn't be treated chemically, there as well.

Our military pilots worked zealously. I don't remember a single case when someone showed fear, a lack of discipline, or disobeyed orders. By May 4 the pilots had buried the reactor core in sand despite conditions that were difficult and dangerous. The dosimetric devices on these helicopters measured radiation levels of up to 500 roentgens an hour. In the first days after the accident those dosimeters went off scale. The crews were exposed to enormous radiation doses during their flights over the reactor. Pilots had to be substituted all the time; afterward, crews were sent to a military hospital in Moscow. Not all of them survived. Recently, military test pilot Anatomy Grishchenko died in the United States. He was the one who tried to lift a huge dome over the exploded reactor with biggest helicopter in the world, the MI-26. He didn't succeed, but he was exposed many times to huge doses of radiation. He wasn't even told about that for a while.

Everything to do with radiation levels was top secret. In early June 1986 I signed for a coded government telegram received from Moscow listing 13 pilots about the consequences of the Chernobyl accident. It included radiation levels, among other things. This coded telegram was signed by General Secretary Mikhail Gorbachev.

I was also exposed to a significant dose. I was hospitalised with symptoms of radiation illness. My situation would have been worse had I not taken certain precautions while in Chernobyl. I believe that cloth masks only protect respiratory organs from large radioactive particles of dust, not from radioactive isotopes, which permeate the air.

I saved my self with cigarette smoke, as strange as that may sound. Along with the inhaled smoke, isotopes of radioactive iodine entered the lungs; then they got absorbed in the smoke particles and were exhaled along with them. In short, I always had a cigarette in my mouth, believing that nicotine would be



less dangerous than radioactive isotopes. My first blood tests confirmed that they didn't get into my body in the first days of work at Chernobyl. Doctors couldn't believe that my tests revealed no abnormalities.

Nevertheless, I can't call myself a healthy man today. My leg hurts, and I limp when I walk. Often I have headaches. I head the Chernobyl Union at the central office of the Ukrainian Ministry of Defence, which consists of military men who worked in the aftermath of Chernobyl. Among other things, our organisation procured the right for the officers who were at Chernobyl to retire five years before the legal retirement age, with a full retirement package.

I spend April 26 in a traditional fashion: I take a bottle of vodka and drink for those who perished at Chernobyl. However, I believe at this point the Chernobyl station should not be shut down. Its safety level right now is practically 100 percent. If so much has been invested in its safety, why take it off line?

April / May/ June /July 1996

Valery Starodumov

Valery Starodumov, a senior engineer working in radiation safety, arrived at Chernobyl on June 6, 1986. His group of cleanup workers of "liquidators" were known as the "rooftop cats," because they cleared the roof-and other areas-of the most dangerous materials before other workers came in. Today, Starodumov serves as chief of Ukrainian Department of Radioactive Waste Management and deputy director of the Ukrainian Government Committee on Nuclear Energy Uses. Now 52, he is married and has two children and a granddaughter. He believes he was exposed to 300 roentgens.

Utter Confusion

It is hardly surprising that in a situation of complete blackout of information, a number of people responded to the rumours by rushing to leave via the road that led through the Red Forest'. Witnesses reported that along this road which was already 'shining' in the full force of radiation, women wheeled prams. There was no plan of evacuation and we did not know which blocks of Pripyat flats or which micro-regions had been placed in which villages. I still can't understand what scheme was used, who was sent where. I would phone a village council and ask "Do you have such and such parentSi their children are looking for them". And the reply "We have such and such children without parents." One would sit all day and phone all the village councils in turn.

The day of my arrival at Chernobyl was my first day of work. When I arrived in the early evening of June 6, I found that there was no one to translate the operating manual for the two German robots, the F-l and F-2, that we needed to work on the remnants of the roof of Unit 4. It took me all night to translate the manual.

Until June 19, I worked on finding a place for a special laundry for washing and treating the clothes of the liquidators. I also tried to analyse the use of various protective substances and working clothes.

Then I was assigned to group of jokingly dubbed the "rooftop cats" by the other .liquidation workers. This group consisted of 32 nuclear experts, drawn primarily from military ranks; it was given assignments in the most dangerous and responsible areas. The head of the group, Yuri Samoilenko, later received the Hero of Socialist Labour medal.

The group's of primary responsibilities were verifying the structural integrity of buildings at the power station, evaluating radiation doses, identifying radioactive hot spots in certain areas around the power station, evaluating the possibility of removing fuel from the reactor taken off line, and other such tasks.

Later we evaluated the feasibility of doing certain kinds of work on the roof of Unit 4. On August 30, 1986, we removed the most radioactive objects on the roof with our own hands. We made it possible for the deactivation workers to enter the breach that we cleared. On this day each member of our group received a "hit" of radiation of 30-35 roentgens. But we were able to lower the overall radiation field at the entrance to this area from 1600 roentgens an hour to 800 roentgens. We did it by tossing the remnants of fuel assembly units thrown there by the explosion back into the reactor.

Army chemical defence units followed us on the roof and into other areas of the destroyed reactor. Many of them were exposed to high levels of radiation; I doubt that all of them are alive today.

All the mistakes that led to high radiation exposure of liquidation workers had to do with the fact that the people doing the work weren't professionals. If we had prepared those who worked on the reactor roof more thoroughly, if we had given them a year-better yet, three year-of preparation;if for this period we had conserved the station under dust-suppressing elements to avoid the release of radioactive elements into the atmosphere; we would have avoided the high number, of causalities and saved our genetic heritage.

In 1987 I was in the hospital from July to October. My hair fell but; three hot particles were found in my oesophagus and intestine. Since then I have not had particular health problems. The pension I received as a liquidator at the Chernobyl power station is laughable. It amounts to a little over $20 a month.

As far as the urgent need to shut down the Chernobyl power station, I think it's a made up problem, more political in nature than economic. The world says the station is dangerous because it is located so close to Ukraine's European borders. However, if you compare the location of other power stations-Smolensk, Kursk, and Ignalia-that have the same kind of reactors as Chernobyl, they will be found to be even more dangerous to the West. I think the main issue here is the fight for a piece of the energy market. Recently a map from Germany and Austria came to my attention. You can clearly see lines going system. The high-voltage line from Chernobyl stops in Austria-Chernobyl still exports energy and someone is interested in getting rid of competition in this market.

Source: Sergei Kiselyov. Bulletin of Atomic Scientists May / June 1996

Heroes *Then*, Zeroes *Now*

It took the Soviet authorities some time to realise the true extent of the disaster on their hands. When they did, there were frantic appeals from ministers for volunteers to fight the invisible enemy 'radiation'. Many did volunteer and there were many others who were conscripted against their will. What is life like for some of them and their families, ten years later.

Vika Troschuk

My husband was woken by an alarm on the night of 26 April 1986. He came home the next evening. He was one of the drivers for the military motorcade which responded to the accident. Both trucks and drivers had to wait for some time in the "auburn forest" but their dosimeters were broken so no one knew what radiation doses they had received.

In 1987 he suddenly lost his consciousness while driving and caused an accident. After that his health deteriorated and he spent a long time queuing at hospitals where no examination or medical treatment was available. In 1990, his health abruptly worsened. He spent six months in hospital having tests. He was diagnosed as suffering from nervous system deterioration caused by radiation and was registered as a second level disabled person.

In autumn of 1994, he got worse. An examination in the Kiev based radiological centre found that his liver was inflamed. But there were no medicines to treat him and he was sent home. He went to the district clinics complaining of pains in his spine and was transferred to a Crimean sanatorium. In March 1995, he was diagnosed as having cancer of the liver and he died in May.

I am 49 and unemployed. At my age it is difficult-almost impossible to find a job. Chernobyl public organisations paid for his funeral. That is all. The state that killed my husband does not see the need to support the family. So survive if you can.

Now Chernobyl has begun to cast its shadow over the life of my son, Ihor. In 1988—1989 he was on military service in Kovpyty, an area contaminated due to Chernobyl. Now, like my husband he is seriously ill. He is fading before my eyes and he does not even have the status of a Chernobyl victim. How can I, poor and stripped of everything help my son? Chernobyl took everything I had. We are now living like a piece of useless garbage on a human rubbish dump.

Chernobyl took everything I had. We are now living like a ple€e of useless garbage on a human rubbish dump.

Vasiliy Osipovich Kotetsky

I began to have health problems in the first few years, but I attributed them to the first hard months of adapting to a new environment, to family problem, to problems of employment and residence, and other causes. But over the past three years it has become worse although I don not smoke or drink excessive alcohol. Both my wife and myself are now certified as level 3 disabled persons. My children (my son aged 16 and daughter nine,) also have health problems associated with the consequences of Chernobyl. We are a typical family of Pripyat liquidators.

There is no rehabilitation and treatment centre for the Chernobyl victims in western Ukraine. District doctors send us to different hospitals or to narrowly specialised medical departments. But our complicated medical problems need complex medical treatment. I do not remember a single day in the past two years that I have felt well. What can I do when my medical card repeated confirms: second grade encephalopathy, dolichostigma, gastritis, cholecystitis, chronic prostatis, haemorrhoids, functional troubles of the left heart ventricle and other "minor" conditions? What can I do when my wife and I have to often massage the legs of our daughter while she groans in pain trying not to wake her brother or the neighbours?

They receive us at medical facilities but often do not register our visits. Several times a year we are sent to the therapy department, the neurological department, to urology, or to surgery. But it is all a mere formality and does not really help.

It is difficult to get a sanatorium voucher. We have to visit a lot of officials and the state regulations on voucher distribution and compensation are amended every year. It takes a lot of time, effort and energy which is not worthwhile in terms of the medical treatment we receive or the improvement in our health. And it all costs so much. Where on earth are these free drugs? The system for distributing compensation and payments to Chernobyl victims is bureaucratic and an affront to human dignity. It is humiliating to show my certificates to everyone, to produce multiple copies of documents, to bow to every mandarin.

We want to see our children make their own lives. We want to give them a little happiness. That is the main purpose of our lives now.

Eugenia Dudrova

I was friends with Olga from our early childhood, as far back as I can remember. We were more than sisters-we were inseparable. We entered school together, studied in the same music classes, spent all our spare time together.

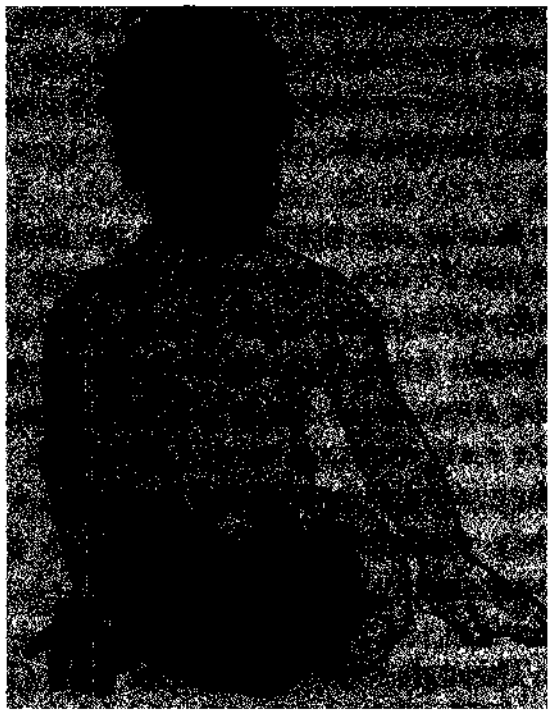
In the spring Olga felt worse and doctors found that she had sarcoma-a deadly tumour. Almost immediately they carried out surgery and she felt better for several days. But then the unbearable pain began again. Olga was very upset that she could not play piano for long. We had a dream to study in the conservatory after finishing school. You cannot imagine how determined she was to overcome her disease but she was soon in hospital again.

Olga's legs became paralysed and shortly after that her arms too. My mother told me that my friend would die soon. I could not believe it. I dreamt that one sunny day a miracle would happen and we would run home hand in hand away from that awful hospital.

But there was no miracle. She prayed for help but we could not help her. Doctors refused to give her morphine saying they were short of the drug and could not use it all for one dying person. One of the doctors told us to take the child to die quietly at home.

1 do not know how to live without her now. I know that I could never find another such friend. I have lost half my life, half of myself. Why did adults create such a disaster? We did nothing wrong. I and my friend were only three years old when the. reactor exploded. I wonder if I face the same fate?

Source: Testimonies: Chernobyl Papers 1 Greenpeace



Containing the Uncontainable

A disaster is not just the initiating incident. It is also the response of the system to the original incident. Proper mitigation efforts can do much to reduce the effects of even serious accidents. As the following article shows, at Chernobyl many of the steps undertaken towards mitigation were of no help at all. Lack of previous planning and an overwhelming desire to hide the facts from the people were the prominent causes for the often unnecessary excessive radiation exposure.

Suppressing Truth Was A
Greater Priority Than Helping The Victims

The Chernobyl accident exposed glaring weaknesses in the Soviet system: its backward technology, its sloppy safety standards, its inability to admit failure. It brought to the surface many of the injustices, inefficiencies, and secrets that the government "had tried to keep hidden.

Old habits die hard. Ten years after the accident, many bureaucrats in the former Soviet Union, particularly in Russia, are still too secretive and too much given to obfuscation.

Heroic, but ineffective

By the time of the Chernobyl accident, Soviet citizens had become masters at avoiding accountability for mistakes and failures. Perhaps no other statement quite capture the essence of this lack of responsibility as one allegedly made by a NIKIET specialist, whose organisation (the Moscow-based Scientific Research Institute of Power Engineering) designed the RBMK reactor series. When asked to aid in clean-up and mitigation efforts, he was widely quoted as saying: "This is no longer a nuclear reactor. Our expertise is in nuclear reactor...so let others clean it up."

And so began an accident containment and mitigation effort portrayed by Moscow as one of the most difficult and heroic engineering tasks ever undertaken. In reality, the period to the end of November 1986, during which the sarcophagus was constructed, was marred by an inept and reckless attempt to conceal the extent of the accident-despite the fact that unwitting "volunteers" (including former Soviet dissidents and political prisoners) risked their lives in several ineffective accident-management actions.

The Governmental Chernobyl Commission (headed by Deputy Chairman of the Soviet Council of Ministers Boris Scherbina) was formed during the morning of April 26, 1986, and in a manner that resembled a cry to arms,

rallied major Soviet organisations and people to mitigate the consequences of the accident. It was clear from the start that no concrete emergency plans had been previously formulated-no one was prepared to respond to an accident of this magnitude.

Il was not until midday on Sunday April 27 that anyone in Moscow had any official idea what had happened. People from the station had surveyed the remains of the reactor building in the early morning hours of the 26th, but they were either afraid to report what they thought had happened, or they were simply not believed.

Through most of the first day, Gennady Shasharin, a key Soviet energy official, thought the core was being effectively cooled by water. Based on this and other incomplete information, the central authorities in Moscow did not immediately sense the urgency of the situation and delayed, for example, the evacuation of residents from what later became the 30-kilo-mcter Exclusion Zone. They didn't want to create panic.

Significantly more radioactivity was released into the atmosphere than Soviet authorities were willing to admit at the first major Chernobyl conference, the IAEA's Experts Meeting in Vienna, in August 1986.

This does not imply that during the active phase of the accident Soviet officials knew that the helicopter campaign had not covered the core. They almost surely believed that the helicopter crews had been successful. But the time of the August meeting, the officials had had ample time to examine the remains of Unit 4 and to conclude, as is obvious from photos, that the core had not been covered.

The scientific finding that the core had not been smothered after all undermines one of the central tenets of the official Soviet version of the Chernobyl clean-up campaign: the cult of the brave Chernobyl helicopter crews who took actions meant to put out the fire, and whose youthful deaths are honoured by a special museum in Kiev.

The Verdict of the

Disastrous consequences of the Chernobyl accident:

- A huge territory (up to 160 thousands square kilometers inhabited by over 9 million people) was contaminated with long-living radionuclides
- Big part of arable land was excluded from economical activities
- Millions of people received significant doses (the collective dose of Soviet soldires that took part in liquidation of the Chernobyl accident in 1986—1988 was higher than 2.64 millions manrem)
- 190,000 residents of the affected areas had to be relocated to clean areas
- There was a sharp increase in somatic and oncological (children's thyroid cancer) diseases; also there were phyetiological stresses that have significant influence on social-physichological state of population.

It is now recognised by specialists that protection measures as well the measures undertaken for localising the accident were not sufficient. Sometimes they were not effective at all.

The low efficiency of the protection measures was mainly due to the concealment of information about the scale of the accident. Absence of legislation regarding radiation protection of the population was another reason. The system of informing about the emergency situation at the NPP was not actualized and no recommandations on the necessary measures of radiation protection were given to public.

The regime of radiation control was put in force only 20 hours after the accident. The headquarters of civil defense of adjacent regions of Belarus and Russia were informed about the accident too late. Another complication arose from the fact that the Chernobyl NPP administration could not understand the dire necessity of timely radiation monitoring. This monitoring was carried out only 12 hours after the reactor had exploded. Some places in the plant had radiation levels up to 200 Rems per hour but because of inadequate monitoring these places were needlessly frequented resulting in a lot of unnecessary doses.

It was only two hours after the accident that, iodine prophylaxis of the plant shift personnel began. The iodine prophylaxis of the Pripyat resident began 10-12 hours after the explosion.

The absence of necessary coordination between the Ministries of Health of the USSR and of Ukraine caused ten days of delay in taking the decision about iodine prophylaxis for residents living in the 60-kilometers zone. As a result of such delays a lot of children received thyroid dozes higher than 500 rad.

In spite of significant material expenditure and participation of a great number of soldires the efficiency of decontamination was low. The positive results of such actions were achieved only on the nuclear power plants sites. In other areas the decontamination had no desired results and only caused the additional irradiation of liquidators. From 1990 the scale of decontamination had. decreased to minimum.

Clearly, these "liquidators" were brave and selfless. They were also, unfortunately, used by Soviet authorities to create an impression in the coming months and years that something had been successfully done to contain the accident.

In August 1986, when Academician Valery Legasov, head of the Soviet delegation to Vienna, was faced with the fact that release of radioactivity began to increase on April 30th and May 1st, and that mitigation efforts apparently had been unsuccessful in stem-

"The people would not understand. We have to be Been doing something.!"

ming these release, he reportedly exclaimed: *"The people would not understand. We have to be seen doing something !"* Later that year, Legasov told the Soviet Academy of Sciences: " I *did not lie at Vienna, but I did not tell the whole truth."* Legasov committed suicide by hanging himself at home on April 26, 1988, two years to the day after the accident.

There seemed to be an overriding desire by the government to convince the people of the Soviet Union and of the world that things were under control, and that the heavily damaged reactor building was isolated and secure. As it was being constructed-and to this day the most visible and attention-drawing symbol of triumph over the accident, the sarcophagus, was consistently portrayed as a tremendous concrete-and-steel engineering achievement that tightly retained radioactive debris. Further, the government claimed there was a complete accounting of the initial inventory of fuel and fission products.

In May 1991, Richard Wilson, professor of physics at Harvard, spoke that first International Sakharov Conference on Peace, Progress, and Human Rights in Moscow. Based largely on extensive private conversations he had with Russian scientists, he summarised several ways in which the Soviet government had attempted to control or censor information about the consequences of the accident:

- On Legasov's instructions, about six pages concerning radioactive releases in Belarus were removed from official report just prior to the August 1986 IAEA meeting and were not discussed.

- Several pages detailing the large quantilies of radionuclidesdeposited 100 kilometers and more Northeast of Chernobyl in the Bryansk oblast of Russia were removed from the report following directives from the Soviet Central Committee.

- Dosimeters in the possession of physicians and private individuals who had worked in the mitigation efforts following the accident were locked up by the KGB.

- Publication of "unauthorised" measurements of radioactivity were forbidden-even as late as 1990.

- Physicians in Ukraine and Belarus were forbidden to mention radiation in their medical diagnoses.

- Appeals by private individuals in Belarus that children not be allowed to drink milk in the first weeks of May 1986 were stopped for fear such warnings might cause panic.

- Health records of the "liquidators" (soldiers and others who constructed the sarcophagus and did clean-up work in the zone) disappeared after their work was completed. (Since the collapse of the Soviet Union, these data have slowly begun to surface.).

The range of the Soviet deception regarding Chernobyl seems endless. Consider the sarcophagus, which one Soviet document called a "concrete cube." The amount of concrete *claimed* to have been used to construct the sarcophagus range from 300,000 to 410,000 cubic meters. However, if one simply takes the cube root of this range of values,, the dimension of a pure block of concrete with these volumes would be in. the range of 67 to 74 meters on a side, This is larger (and certainly taller)than the actual sarcophagus, which is mostly empty space.

According to the structural drawings of the sarcophagus, the amount of concrete actually used in constructing the sarcophagus was about 161,000 cubic meters, which is still a lot of concrete. But a great deal of it leaked through holes in the reactor building onto the grounds of the station, or was used to cover the ground to shield workers.

The net affect of the government's propagandists claims was to draw attention away from the affected people and the extensive contamination of the environment, including great tract of agricultural land, and focus it on the sarcophagus, which represented "victory" over the accident. The Soviet leaders themselves wanted more than anyone else to believe that most of the contamination was contained within the sarcophagus, and so the stage was set for the creation of a myth that would remain unquestioned for several years.

"They should have given a little thought to the problem before acting so haphazardly," is the restrained assessment outside experts often make of the Governmental Commission's methods. Rather than carefully thinking through mitigation efforts, the Governmental Commission's intention were dictated by the passion to remain in control. For example, one must question the wisdom of constructing an 8.4 Kilometre perimeter wall, which was sunk into the ground to a depth of 30 meters. The project, known as *Casa Grande* , was abandoned when only partially complete. It was supposed to surround the station and stop the spread of radionuclides to nearby bodies of water.

The project was abandoned because by the time the workers were ready to extend the wall through the "Red Forest" (so named because the trees turned reddish before dying), the army had not got around to decontaminating the area. One bureaucratic tie-up led to another and the project was eventually "forgotten."

Meanwhile, the partially constructed section of the underground wall between the station and the Pripyat River acts as a dam. The result: the level of the ground water had risen to within 4.5 meters of the surface by 1992, according to Aleksandr Borovoi, head of the Department of Radiation Research at the Kurchatov Research Institute in Moscow. That is, the ground water level, which seems to have reached equilibrium, is much closer to the contaminated now than in 1986.

Another line of defence that was as ineffective as *Casa Grande* was the valiant attempt by miners and engineers to construct a heat exchanger below the core by tunnelling beneath the foundation of Unit 4. The reasoning: In the event of a much-feared "China Syndrome," there would be one more barrier between the ground water and the molten core. The project was undertaken Well after the active phase of the accident, and when it became clear there was no danger of a melt-through, it was abandoned. Workers in the area now call it the "Moonshine Still," because of its complex array of cooling pipes.

How much fuel?

No one actually knew how much nuclear fuel was left inside Unit 4 after the accident, nor did anyone know its condition well enough to predict its future behaviour. Preliminary analyses of hot particles in Sweden and Germany indicated that approximately 3 to 6 percent of the *mass* of the core, or about 6.7 metric tones, had been released beyond the bounds of the station. Based on these early results, the Governmental Commission hastily decided that 96.5 percent of the initial 190.2 ton fuel load was still located within the core region. This official estimate became the ultimate arbiter, the criterion to support the notion that the fuel had been accounted for and was tightly held within the sarcophagus. It was the key bit of the data with which to convince the World that everything was under control.

The Soviet leaders themselves, it seems, wanted to believe this, even if based on questionable evidence. For example, one of my colleagues recalls an incident at the Kurchatov Institute in which measurements by the *Igla* System (a wand like probe suspended from a helicopter) were presented and interpreted. In analysing the *Igla* date, it was concluded that the largest amount of fuel was contained within the reactor core area. Following this, an internal document was prepared detailing the locations and quantities of fuel within the reactor building.

The document seems to have been used to provide information to the IAEA's Experts Meeting in August 1986. Unfortunately, not only there-was almost no fuel in the reactor core area (the core shaft is virtually empty), but a few years later, when researchers entered the area of the Central Hall to examine more closely the remains of the reactor, the *Igla* detector wand was found to be jutting partially out of the southern spent-fuel pool, approximately 12 meters from the reactor shaft, and it remains there to this day.

How much radioactivity was released into the environment? That is still a contentious question. In 1986, the Soviet estimated 50 million curies. In my study, I concluded that the release of volatile radionuclides at Chernobyl was actually two to three times the Soviet figures. That was in line with earlier Western suspicions regarding the releases, and the estimates arc compatible with early satellite imaging investigations.

In fact, a recent publication by the organisation for European Cooperation and Development presents the findings of Swedish investigator Lennart Devell, which suggest an even greater total release of about 200 million curies, if one adds the contribution of the volatile isotopes, iodine 133, caesium 136, and tellurium 129.

Sadly, these higher release estimates support conclusions drawn by medical experts in a recent study by the World Health Organisation, which directly links the marked increase of childhood thyroid cancers and other maladies occurring in Belarus and Ukraine to releases of radioiodine from the accident.

An invincible bureaucracy

Ten years after the accident, Chernobyl is plagued by bureaucratic inertia. It is not always clear who is in charge of what in the zone. Every organisation associated with Chernobyl or the zone attempts to aggrandise its role. Organisations with curious acronyms such as Derzh Kom Atom, MinChernobyl, MinEcoBezpeka, ISTCShelter, and NVO-Pripyat all claim at least some jurisdiction.

The station controls access to the sarcophagus, and it is not eager to permit scientists to conduct research if their findings might help tip the scale towards eventual closure of the station. It is no wonder that people in Ukraine often describe the zone and the work there as *bardak-a* Russian word that literally means "whorehouse," but colloquially implies complete confusion and disorder.

The conditions under which scientists work at Chernobyl can only be described as tragic. There is a core group of about 30 of them struggling with, an "invincible" bureaucracy that serves only to impede their work.

Today, a brief tour of the zone will show anyone that little work has been done to properly dispose of now-radioactive equipment used during construction of the sarcophagus. Located just to the west of Unit 4 is an entire field of contaminated, uncovered, and rusting machinery and supplies.

Moreover, approximately 25 kilometers Southwest of the station near the

small village of Rasokha are two " machine graveyards" shopping-centre-sized areas full of fire trucks, military vehicles, and helicopters used in 1986 during construction of the sarcophagus and decontamination of the surroundings. All of these are contaminated and standing in the open, surrounded by a double barbed-wire fence-with holes. Astonishingly, workers in the zone, including some of the scientists and technicians, frequently cannibalise this radioactive equipment for spare parts.

The dollar curtain

One of the terrible ironies of Chernobyl is that the world's worst nuclear-power accident has been so thinly investigated. Only 30 or so dedicated scientists struggle to find enough gasoline to drive to the reactor where they risk heir lives to make their measurements.

Over the past decade, the lack of contact with Western colleagues for these scientists has also taken its toll. While the iron curtain is long gone, it has been replaced by a "dollar curtain." With the economies of the newly emerged republic struggling to fulfil basic needs, financial realities limit scientific exchanges.

Alexander Sich
Bulletin of Atomic Scientists

Lessons Not Learnt

What if an accident on the Chernobyl scale were to happen in India? What would be the response of the authorities? Would the experience of earlier disasters like Bhopal or Chernobyl help other victims?

In India, the answer in short is no. The nucleocrats have been so busy in denying that accident can happen at all, that they have not bothered very much with learning what Chernobyl could have taught them.

Worse than having no plan!

The first and foremost point that strikes one about Chernobyl is the absence of previous planning. If only the authorities'had known what to do in case of an emergency, one would not have witnessed the bungling described earlier. If only the firemen would have been trained earlier on the hazards associated with radiation, they would not have picked highly radioactive graphite with bare hands, would not have dawdled over a smoke in areas of intense radiation. If only more working dosimeters were available, authorities could have had much earlier warnings of the severity of the disaster. If only iodine tablets had been distributed previously in the health centres of the region, the children would not have taken in high amounts of radioactive iodine in their thyroids and would not have suffered high incidence of thyroid problems. If only more doctors were previously trained in recognising radiation symptoms they would not have had to learn everything on the fly. If only...

Till 1987, Indian nuclear power plants did not have emergency preparedness plans at all. Like the Soviet authorities, Indians too felt that an accident was so unlikely that there was no need to prepare for one. Also the argument went that planning for a possible accident would create panic amongst the populace who had been fed stories of the impossibility of an accident in a reactor. One fallout of Chernobyl was that emergency plans were prepared and periodic drills have been held. However, the plans have been made with such a singular lack of imagination, that they are worse than having no plan at all.

Getting contaminated in order to avoid contamination

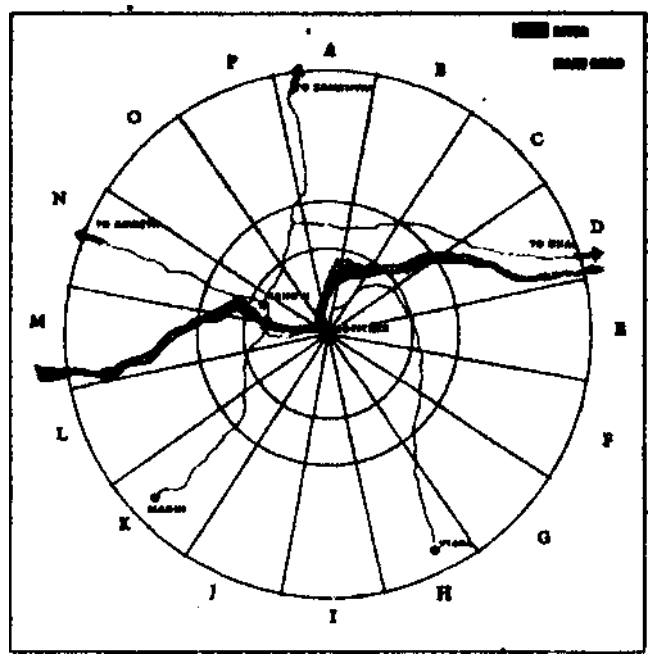
In Chernobyl all the people living in 30 km radius had to be evacuated. The accident was not just one explosion on April 26. The reactor continued to spew radioactivity on and on for well over a fortnight before things came under relative control. During this fortnight, winds did not remain confined to just one direction, they changed course. So, at different times, different regions of the country were affected. Also, depending upon the rainfall patterns, pocket's hundreds of kilometres away from Chernobyl were severely contaminated. Absence of measuring equipment and trained personnel meant that a number of such regions were not detected quickly. The authorities in fact transferred some of the evacuated population from near Chernobyl to such areas and then found that these areas were themselves as badly affected as regions near Chernobyl, and thus there had to be a second evacuation.

Let us consider the Kakrapar evacuation plan in the light of this experience. The plan confines itself to just 16 kilometres radius since doing anything more would mean evacuation of such large numbers that even our can-do everything authorities feel it to be beyond their capacities. The whole area has been divided into 16 sectors, numbered from A to P in a clockwise direction and the plan is that if the wind direction is towards sector A, then the population from there would be moved to schools in villages beyond 16 kilometres in section D (See figure). In case the wind direction is towards sector B, the plan calls for the evacuation of the population in that sector towards sector E, and so on clockwise for all sectors. This plan is totally oblivious of the geography of the area. The river Tapti

runs from East to West, and the only bridge is near Mandvi about 5 km from the plant. Thus in this plan, if you happen to live anywhere in sectors B, C, D or in sections J, K or L, then you would have to cross the river by going to Mandvi. Thus, in case the wind is in. any of these directions, people will first have to travel opposite to the wind direction to get to the bridge getting themselves contaminated in the process in order to escape the contamination in the first place. Of course India being the land of Vayu and Maruti, we can order the winds to continue flowing in one direction only while the evacuation takes place.

This is just one of the many obvious follies of the plan. It envisages keeping whole towns like Vyara (population 40,000) in a high school which can't even accommodate 5000 people packed like sardines. Or a town like Mandvi (population 15,000) and two other villages are to be accommodated in the primary school of a small town of Mangrol whose total population is less than 7,000. Such absurdities are of course, no concern to people asked to devise an emergency plan to satisfy international pressures. Things like the total absence of toilet facilities etc. are way beyond their ken during emergencies. A surefire recipe for epidemics to follow the accident.

Most of our reactors are fairly close to state boundaries. This is a general feature of reactors world-wide. Beneficiaries are generous in sharing risks with non-beneficiaries. However, the emergency plans are state civil authorities concern and thus Gujarat has no emergency plan for Tarapur whereas Maharashtra has none for Kakrapar though both the reactors are close to the state boundary.



Kakrapar Nuclear Power Plant and Surroundings

Anything connected with nuclear is a state secret

The absence of previous planning is only one of the points raised by Chernobyl. The other major point is the obsession with secrecy which denied people information about the status of the disaster and their own health for years on end. It is this feature of Soviet style which Indian officialdom has embraced with gusto. Thus although emergency preparedness plans have been prepared for whatever they are worth, they are not available to the general public even after repeated requests. The nuclear authorities will refer you to the civil authorities and the civil authorities will in a civilised manner inform you that only nuclear authorities are authorised to divulge the plan. It is another matter all together that people living near such hazardous facilities have no scruples in obtaining such information clandestinely.

Surendra Gadekar

Nucleocrots *of the World, Unite!*

The International Atomic Energy Agency (IAEA) still clings to the myth-first promulgated by the Soviets-that 5,020 metric tons of sand, clay, dolomite, boron carbide, and lead dumped from the helicopters in the first few days after the Chernobyl accident found their mark and succeeded in smothering the "burning" Unit 4 core.

But it is now clear that the helicopter pilots did not cover the core. Rather with pinpoint bombing accuracy performed under extremely hazardous conditions, these brave pilots managed to smother the infamous "red glow," which was thought to be the burning core. Unfortunately, the red glow is now widely assumed to have been only a minor portion of the core, thrown up and away from the reactor in the devastating steam explosion. The location of the red glow was 12 to 15 meters from the reactor core shaft, on the floor of the Central Hall, which was left roofless by the explosion.

About 71 percent of the fuel in the core (roughly 135 metric tons) remained uncovered in the reactor shaft after the explosion. Eventually the fuel melted through the reactor's lower lid and flowed into the lower regions of the reactor building, where it cooled and hardened into lava-like substance. About 25 percent of the core was scattered in and around the remains of the reactor building, and almost 4 percent dissipated into the environment-producing radiation contamination that was detectable over the entire northern hemisphere.

The bottom line: most of the core remained in the Unit 4 building, as the Soviet later said. But instead of being smothered, the core remained exposed to the environment, releasing radioactivity into the atmosphere for nearly 10 days, at which point the remnants cooled down on their own.

IAEA: Hand in Glove with the Soviets

Even today, the IAEA's official position, first expressed in INSAG-1 the International Nuclear Safety Advisory Group's review of the Soviet Report presented in Vienna in August 1986—support the Soviet version of events. It concludes that "accident management actions taken at Chernobyl were, generally, quite successful." Dumping the materials into the reactor shaft, the review added, "stabilised the situation at an early stage."

The IAEA's defence of this position, based preliminary on information provided by Soviet government, seems particularly awkward today, because data and analysis indicating that the core had not been smothered became available in the West at early as 1989. Even more embarrassing, is that the IAEA itself sponsored a 1990 report by Aleksander Borovoi, one of the key scientist investigating the Chernobyl accident. His data clearly indicated that the Core was not covered by the materials, and that approximately three times more caesium 137 was released into the atmosphere than the Soviet had admitted. The IAEA apparently ignored Borovoi's work.

My research at Chernobyl, which partially drew on the courageous work of Borovoi's and his Russian and Ukrainian colleagues, eventually led to a broad reappraisal of the accident and its consequences. The main intent was to recreate the sequence of events during the nine days following the explosion, when the destroyed reactor was actively releasing radionuclides into the environment.

After my findings became known in early 1994, Morris Rosen, deputy director of the IAEA, noted that he had flown over the reactor in May 1986, and he could vouch for the fact that "the material certainly got into the core region." My work, an IAEA spokesperson told a newspaper reporter in 1994, was "flawed and not worthy of serious attention."

Indeed, it is aerial observations of the destroyed reactor that were more likely to be flawed. For one thing, the 2,000-metric tons Upper Biological Shield-the reactor's "lid"-was perched, at cockeyed angle, above the reactor well, blocking the view into the reactor core.

Need to be Sceptical of Official Russian Data

During the general discussion, the chairman Dr. Shigematsu, stated that there were no cases of paediatric cancers of the thyroid in Russia. The Russian physician who presented 67 cases of thyroid cancers in children, recently operated in a centre close to Bryansk, stated the contrary. The chairman indicated he had been informed that there was no epidemic of thyroid cancer in Russia, during a medical conference on the same subject in Japan, less than two months earlier. The explanation for this misunderstanding, was the fact that, within a few months, the official attitude has changed: in Russia, facts regarding thyroid cancer may now be published.

Meanwhile, over the years, the scientists who have actually entered Unit 4, at great personal risk, have taken about 200 bore samples and have made enough visual and robotics observations to conclusively prove that virtually none of the material from the helicopters entered the core shaft. If it had, significant amounts of it would have been found in the lava like remnants of the core. In fact, only traces were found.

In retrospect, the IAEA's approach to Chernobyl should surprise no one. After all, the IAEA is in the business of promoting nuclear energy, not discouraging it. For ten years, the agency has attempted. to downplay the consequences of the accident. In 1987, for example, well before information began to filter out the Soviet Union on the true extent of the accident, an IAEA report reassuringly said, "If anything, there will be a modification downward of early calculations of risks and predictions of health consequences."

And, too, the IAEA has been markedly unaggresive in questioning official Soviet and Russian Chernobyl data and analyses because the Soviet Union (and now, Russia) plays a significant role in the governance of the IAEA.

For several years after the accident, the IAEA seemingly ignored specialists from republics other than Russia, which dominated the Soviet central government. But Russian data were controlled and often suspect: Russia had 11 Chernobyl-type reactors essential to power production, and thus it had clear political need to minimize the consequences of the accident.

Dealing almost exclusively with the Russians, however, not only restricted IAEA access to information, it alienated the IAEA from the people of Ukraine and Belarus, the republics most affected by the accident. The IAEA didn't help matters by derisively labelling as "radiophones" those who were genuinely attempting to draw attention to the accident's health effects.

To battle over the body count misses the point: Is not one victim enough to condemn a reactor design long known to be deficient? However, the IAEA attitude has been characterised by Deputy Director Rosen's careless statement at Vienna conference in August 1986:*

"Chernobyl shows us that even in a catastrophic accident, we are not talking about unreasonable numbers of deaths."

Alexander Sich
Bulletin of Atomic Scientists

Verdict on Health: Plenty to Worry About

As recently the summer of 1994, the British Medical Journal was headlining its editorial on Chernobyl "Probably nothing to worry about".

Unfortunately there's plenty to worry about: Scientists were expecting that the first disease to appear would be leukaemia since that is what had been observed amongst the Hiroshima and Nagasaki survivors. Everyone is now agreed that, although childhood leukaemia have not shown that sharp an increase, there is a dramatic and increasing incidence of thyroid cancer in the most contaminated areas.

Several scientific meetings were organised in connection with the 10th anniversary of the Chernobyl disaster. The World Health Organisation (WHO) planned the first of this series from November 20 to 23, 1995 in Geneva. At this conference, results of the "International Programme on the Health Effects of the Chernobyl accident (IPHECA) pilot projects, and related national programmes, were presented.

Who are the affected?

Those affected fall mainly in two categories. One are the liquidators- the men and the women called in to clean up immediately after the accident. They should be the first to feel the effects from Chernobyl. Studies reported to the WHO from Ukraine and Belarus are beginning to suggest that cancer is increasing among them, but the results are far from conclusive. No one even agrees how many liquidators there are. The WHO figures of 800,000 was briskly dismissed as grossly exaggerated by Leonid Ilyin from the Russian Federation Ministry of Public Health. Ilyin says the real number was closer to 200,000.

One of the reasons why such a large force was conscripted to decontaminate the reactor surroundings was that the neighbouring units I, II, and III could continue to produce electricity since Chernobyl was one of the largest electricity generating station in the Soviet Union. Liquidators are under permanent stress, especially as nobody is in a position to indicate the actual consequences for their health because of their engagement.

The other group are the more than 2 million inhabitants of the region around Chernobyl, living in contaminated parts of the three CIS-countries, Belarus, Russia, and Ukraine. Their situation differs from that of the liquidators. The intensity of irradiation may have been less than for liquidators, but the duration of exposure to radiation is much more prolonged, already a decade. The assessment on the actual risk for the population has to be studied by the medical community. Much less is known for such a chronic situation, compared with the risk following an irradiation limited in time. Chernobyl could give an opportunity to learn precisely the clinical risks associated with low dose radiation. The consequences of such studies will allow to take preventive measures in the future.

The epidemic of thyroid cancers is likely to continue for decades and involve many thousands of children. As many as 40% of the children exposed to the highest levels of fallout from Chernobyl when they were under a year old could go on to develop cancer as adults.

The Scale of the Problem

Dr. Valery S. Sorokine, from Russia, said that there were 80 million persons irradiated in the country. This figure includes persons living in areas of Russia where earlier accidents and routine dumping have occurred. Besides Chernobyl, there is the Altat, Chelyabinsk, Oural, Kazakstan, Kola, and many other territories contaminated by nuclear wastes, accidents or atomic explosions. In this country, control groups must be selected in clean zones, which may be difficult, as 17 million hectares are contaminated.

For Dr. Y. Korolenko, Minister of Health of Ukraine, 30 million inhabitants drink water contaminated with radionuclides. He indicated that 600.000 square Km. had to be abandoned, this includes fertile soils, and 40% of the forests of the country. Today more than one million persons are living in contaminated areas, with more than 5 Curie/square metre.

For the Vice-Minister of Health of Belarus, Dr. N A Krysentko, 23% of the national territory is contaminated, 2 million persons-including 410.000 children- have been or still are irradiated.

Millions of refugees exist worldwide. However, when evacuated from a radio-contaminated area, refugees cannot consider returning home for their life-time or a very long period. The absence of such hope affects hundreds of thousands; this has detrimental psychological consequences. Furthermore, the 200.000 refugees are aware that they have already been irradiated before leaving their homes, i.e. they are at higher risk than others of suffering from cancer or giving birth to deformed children. Unfortunately, nobody informs them accurately about the risks.

Thyroid Cancers in Children

Before the accident in the regions surrounding Chernobyl the annual inci-

dence in the children under fifteen years was 0.5 per million children (a similar incidence as in the UK). 680 cases of thyroid cancer have now been confirmed in Belarus, Ukraine and Russia since the accident; the cases are concentrated in an area where rain deposited the heaviest iodine contamination, more than 200 kilometers north of Chernobyl. The incidence in the Gomel region of Belarus is more than 100 per million. The epidemic is likely to continue for decades and involve many thousands of children. According to Dillwyn Williams of Cambridge University, as many as 40% of the children exposed to the highest levels of fallout from Chernobyl when they were under a year old could go on to develop cancer as adults.

Iodine deficiency

The exact cause of the increase in thyroid cancer is still not clear. The incidents in children born more than 6 months after the accident seems to be much lower, suggesting that early inhalation and ingestion of radioactive iodine were responsible. It is not clear at present whether iodine-131 is solely responsible, or whether other short-lived isotopes (iodine-130,132, 133 and 135) are implicated too; the amount of iodinc-133 released was almost a third of that of iodine-131. Uptake of radio-iodine was further increased because regions surrounding Chernobyl are deficient in iodine, and iodine deficiency disorders (e.g., goitre) are common; and for the same radio-iodine intake, an infant would receive about ten times the absorbed thyroid dose as would an adult.

The surgery of such cancers is devastating, with the risk of harming the parathyroid glands. As a consequence, treatment of children with thyroidectomy is very difficult, and costly. This represents a dramatic health problem for countries in severe economical crises. If there exists a concomitant deficiency of parathyroid hormone, the therapeutic measures to be taken become even more problematic.

The atomic industry promoters, claim that thyroid cancer is the only neoplasm associated with the accident, and furthermore that this kind of cancer is usually not lethal, because it is easy to treat. This is contrary to the truth and cynical. Treating malignant and endocrine diseases in small children is much more difficult than treating the same condition in adults.

Some scientists assumed that the increase in thyroid cancer was just due to 'ascertainment bias' (i.e., the harder researchers look for an effect, the more likely they are to find it). There has been a reluctance on the part of some scientists, particularly in the US, to accept that iodine-131 is the cause, partly because there is no clear evidence of iodine-131 having caused thyroid cancer when used therapeutically, as it often is, to treat overactive thyroid. However, there may be a big difference between giving large doses of iodine-131 to an adult, diseased thyroid - with the object of killing as many of its cells as possible -and low doses to the normal thyroid of an infant or child, where the potential for mutagenic effects could be far greater. More worrying, it has been suggested that government scientists in the US may want to play down the effects of the release of iodine-131 because of the large quantities released from the Hanford nuclear site in the 1940s.

'Good' Cancer Propagandists

The atomic industry promoters, claim that thyroid cancer is a 'good' cancer since it is usually not lethal, and it is easy to treat with replacement therapy. Unfortunately, it is difficult to treat afflicted children anywhere, especially so in countries where the accident and social disruption, has meant a severe shortage of funds for medicines and medical services

One reason that seems to make ascertainment bias unlikely is the aggressive nature of the disease; affected children quickly become unmistakably ill with secondary cancers in the lymph nodes of the neck and lungs. Treatment can be high doses of iodine-131, but obviously administering yet more radioactivity is difficult. The alternative is surgery, but there is a problem here too: it is usual in thyroid cancer to remove the whole thyroid, but the scarcity of thyroid replacement hormone has made some surgeons reluctant to do total thyroidectomies; instead they remove only part of the thyroid, which may miss some of the cancer cells.

Whatever the exact mechanism responsible for the increase in the thyroid cancer, at least one thing seems clear: the recommendations and arrangements for iodine prophylactics in future accidents have to be looked at very carefully. For the thyroid, the National Radiological Protection Board specifics a low 'emergency reference level of 30mSv - if the predicted dose to the thyroid is likely to exceed this, administration of prophylactic iodine may be justified. If the predicted dose is above 300mSv, prophylactics is deemed essential. As a result of the Chernobyl experience it has been argued that the lower limit should be reduced to l0mSv, at least in children.

What further cancers can be expected in those most exposed? The World Health Organisation (WHO) points out that the tissue most sensitive to radiation exposure, in addition to the thyroid and bone marrow, is the breast of the young women; populations within 100km would be particularly at risk, and we may expect a rise in the incidence of breast cancer. Effects of airborne radioactive particles on the induction of skin and lung cancers is also a matter for concern. And the 'liquida-

tors' - about half a million people, mostly young men, who cleaned up.after the accident - are reported to have an increased incidence of cardiovascular disease, not normally associated with radiation exposure.

Other Non-Cancerous Effects

Several researchers from the former Soviet Union argue that radiation from Chernobyl is also causing increases in a range of non-cancerous diseases. Alexei Okeanov from the public health research centre in Belarus, for example, says the Chernobyl accident is responsible for an unqualified increase in the rate of cataracts, cardiovascular disease and hyperactive thyroid glands. The link between radiation and cataracts has been well established by studies of Japanese A-bomb survivors. But Western researchers have been sceptical of links with other non-cancerous conditions because they do hot have a well understood causal link.

However, a new study of the A-bomb survivors presented in Geneva provides the first serious evidence that radiation may help to trigger strokes, heart disease and cirrhosis of the liver. Direct correlation between radiation exposure and all three conditions are highlighted by researchers from the joint US-Japanese Radiation Effects Research Foundation in Hiroshima. They also reveal evidence that hyperactive thyroids and non-malignant tumours in the uterus, ovary, stomach and thyroid.

"We are now almost sure that non-cancerous diseases have increased among atom bomb survivors," says the head of the foundation, Kazunori Kodama. "But we need extensive studies to discover "why." One possible clue is that cholesterol level in the blood, which is a risk factor for strokes and heart disease, are higher than average among A-bomb survivors.

Increasing Mental Retardation

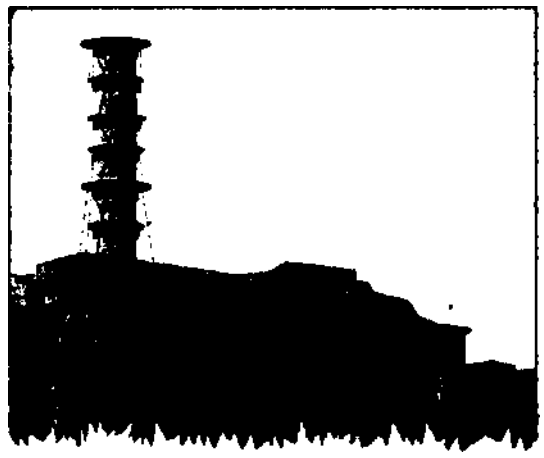
More disturbingly, evidence is emerging that radiation may have damaged the developing brains of foetuses in the womb. The WHO is sponsoring a study to compare the cognitive abilities of 2189 children born in contaminated areas. Preliminary findings suggest that children from the contaminated areas are suffering more mental retardation, more behavioural disorders and more emotional problems.

According to one the project's researchers, Irina Kozlova from the Russian Academy of Medical Sciences, half the children irradiated in the womb have experienced "some kind of mental disorder". A higher than average proportion of them, she says, have an IQ lower than 70, which suggests they are likely to be mentally retarded. Precise figures will not be known until the research is completed. Kozlova thinks that even very low levels of radiation could damage neurons in the brain of a foetus.

"We cannot rule out the effects of radiation on the developing brain," agrees another researcher from the WHO study, Anagelina Nyagu from the Ukrainian Academy of Medical Sciences. "The problem of prenatally irradiated children is unfortunately going to be priority." These findings reinforce those from Hiroshima, where 1100 children exposed to radiation in the womb also suffered a higher than average rate of mental retardation.

Thousands of adults have also experienced psychological problems in wake of Chernobyl, but not because their brains have been harmed by radiation. Uncertainties about radiation risks, coupled with the social dislocation provoked by large-scale evacuation programmes, cause anxiety and stress. Real or imagined health worries, loss of homes, changes in jobs and financial difficulties precipitate depression.

Terence Lee, professor of psychology at St. Andrews University, says that people around Chernobyl feel powerless and fatalistic, a condition he calls "chronic environmental stress disorder". The solution is to give them reliable information about the risks of radiation from sources they trust, he says.



"The atomic Mafia seem to believe that the problem can be solved by slides showing multicoloured entrails of nuclear reactors, but this is of course to no avail."

Birth Defects

Very few studies have been done on this subject. Prof. G. Laziuk has described genetic anomalies in new-born: amelia and polydactylia increased. This increase is not directly proportional to the dose received. To reduce the number of malformations, pregnancy interruptions became more frequent: from 12.5 to 17.4/1000 between 85 and 94.

It has been published that malformation in pigs and calves have increased by factors 100. In some places, it is no more possible to breed pork, as there are too many malformed offspring.

Research Effort in Absolute Chaos

Distinguishing between disease caused by radiation and disorders provoked by stress is just one of the problems faced by researchers. Obtaining a clear picture of the health effects of the accident has been hampered by the disintegration of the Soviet Union and clash between Eastern and Western European scientific cultures. According to one senior researcher, the entire international research effort "is in absolute chaos".

Insiders say that, instead of collaborating, research institutes in Belarus, Ukraine, Russia, Europe, Japan and

America are competing for the same limited set of health data. Some researchers allege that political differences, national chauvinism and the egos of individual academics are preventing serious co-operative science. International collaboration, admits Baverstock from WHO, is "disgracefully poor." As a result research is fragmented and its conclusions often disputed. Baverstock points out there is no real, mechanism for exchanging information. He is pessimistic about whether collaboration will ever improve. The credibility of the international scientific community is at stake, he says.

Dr David Sumner
Chernobyl: Ten years on,
Safe Energy Journal

Preparing for the Next Chernobyl

For most people in the world, one Chernobyl is enough. But there is a lobby which is so addicted to nuclear power and believes that it is such a wonderful source of energy that it cannot under any circumstances think of abandoning this madness. When questioned as to the number of fatalities the accident had caused and the impact of the accident on Soviet society and Soviet nuclear industry, A.M. Petrosyants (then chairman of Soviet State Committee on the Utilisation of Atomic Energy) responded: "Science requires victims." M. Hans Blix, (the long time chairman of the International Atomic Energy Agency (IAEA) and a well travelled spokesman for this lobby)declared in 1986 that "due to the importance of this source of energy, the world could support one accident of the Chernobyl scale every year...."

It is against this background of cockeyed conviction that one must examine the bizarre contributions of the nuclear lobby. The International Atomic Energy Agency (IAEA), the UN body responsible for promoting and policing nuclear power, argued that government decisions to evacuate more than 135000 people and to impose widespread restriction on farming and food consumption harmed the lives of "hundreds of thousands, if not millions of people".

Belarus Authorities Let People Return to Chernobyl Territories

Authorities of the Belarus Republic have launched a campaign to return people to regions which have suffered from the 1986 accident. The campaign was begun after Belarus President Alexander Lukashenko declared upon visiting the Chernobyl territories that people should return to abandoned lands. Soon thereafter, the president's Academy of Administrative Management developed an unusual document entitled "Programme for improving public information on problems of Chernobyl and radiation safety."

The document states that public consciousness exaggerates the consequences of Chernobyl accident. One item of the action plan calls for directing public attention to positive factors by propagating positive information.

The program also foresees a campaign to influence top officials in the media and to influence the public through the media. The authors specify the use of works such as "Psychological warfare" and "Manipulation of consciousness." State newspapers are already working according to this programme.

The new Chernobyl policy is based on conclusions of government scientists that over the past 10 years, Chernobyl—contaminated territories have been substantially cleared of risk due to natural radioactive disintegration. This conclusion was also the basis for the government's decision to rehabilitate the abandoned lands. According to data from the Emergency Ministry, 6,000 hectares of contaminated territories are already in use.

The director of the Institute for Radiation Safety, Academician Vasiliy Nesterenko, believes Lukashenko has made a serious error. Nesterenko points out that the official physicists have based their reasoning about radioactive disintegration only on strontium and cesium, ignoring other radioelements. He believes development of the contaminated territories is premature at this time. Nesterenko notes that about 70% of the radioactive particles emitted by Chernobyl-4 fell on Belarussian territories.

Nevertheless, the resettlement campaign is going forward, primarily because j of the country's economic crisis, unemployment, and shortage of arable land. People are coming back to the Chernobyl zone, where there is work for them. Last year, crops were harvested on developed lands. This year, it is planned to expand the arable land by a few thousands hectares.

Peter Coryn, Chernigov, Ukraine
Nucleonics Week

The IAEA claims that radiation exposure will result in a marginal and probably "undetectable" increase in cancer. Cases of thyroid cancer will amount to "a few tens in a million per annum". Last year, the number of children in Gomel who contracted the disease reached 240 per million.

Filthy Lucre Ahead by a Mile

The objective follow-up of populations after the Chernobyl catastrophe, should have given the world an opportunity to improve our knowledge about the risks at low doses. Studies performed during the last decades, have shown that earlier dose limits were always set too high, and that lower limits would be safer. But in this competition between sound health of large populations verses the bulging pocketbooks of some, il is the greedy who art winning. "Experts" have already decided to increase limits of accepted contamination of water and food, before data becomes available from conclusive studies.

Politicians and experts supporting atomic energy, including those of IAEA, and experts from France, intend to change the official limits for radioprotection. These experts wish to change rules so as to reduce the immediate cost of future accidents. For the promoters, the limits assigned after Chernobyl accident have to change, in the sense that much higher radiological contamination should become legally acceptable.

Furthermore, the contamination labelling needs to become so complex that grocers or border guards will not be in a position to decide by themselves if milk, meat, or vegetables are safe or not to be given to children or adults. Instead of "Becquerels per kg." of food they now want to subdivide this into Becquerels for each individual radionuclide: Caesium, strontium, etc. This require new apparatus. Globally, however, the aim is that contaminated food be considered less dangerous than it is today. Again, the aim of such changes is to reduce the responsibility of nuclear industry, and reduce the cost of preventive measures for the "next Chernobyl."

Dr. Michael Fernex

The Tricks of *the*

The general aim of epidemiological trials is to find out if an event has health consequences. However, if experts begin with a motive of not wanting to demonstrate consequences, inadequate studies can be undertaken which will 'prove' that effects do not exist. Such studies usually suffer from the following sources of error:

- Selection of wrong health indicators: e.g. mortality instead of morbidity.
- Screening for the wrong pathology: e.g. ignoring leukaemia, digestive, lung, mammary carcinoma.
- using the wrongtiming: e.g. ignoring long incubation period, then declaring "10 years after Chernobyl, nothing more can be expected. We know how to manage the next accident."
- selecting the wrong target group: e.g. not studying the most susceptible group or not selecting the group with the highest exposure.

Having thus selected either wrong methods or wrong targets or both :

- the results will show no statistically significant difference with any control group.
- the conclusion will be that the hypothesis was wrong.
- the consequence will be that the authorities will be convinced that everything is under control and business as usual can proceed.

Revittimtsatlon: A sorry tale with no *ending Three Mile Island, Bhopal and Chernobrl...*

"There is no free lunch. Somebody has to pay the price of development." How often have we heard this from those who pay no price at all for anything. But that is a different tale. To the victims, development is not a good whose price is paid once but an unending nightmare which demands an undefined, unbounded payment which continues on and on.

Take the Three Mile Island accident for example. On 31st March 1979, a stuck valve started a series of events which culminated in a partial melt-down of the nuclear reactor. Fortuitously, the accident did not result in a

huge explosion with a large release of radioactivity to the environment, but nevertheless there was radioactivity release to the environment in excess of prescribed 'limits'. People living near the reactor did suffer harm. Infant mortality and spontaneous abortions, congenital deformities in both humans and animals in the region rose in a significant manner. But to the nuclear authorities, these were of "no concern to the community." More than 2,000 victims of this disaster have filed court cases against the owners and operators of the plant, but they got their chance to tell the Court about their injuries and sicknesses only in June 1996, that is fully 17 years after the disaster. On 27th February, 1996, the United States Supreme Court turned down the argument of the nuclear industry, put forth by the owners of the reactor with the support of their nuclear "experts" in the industry, that even though the radiation exposure of the people was above federal limits no one was actually exposed to "excessive* radiation and therefore no one experienced radiation detriment. Most of these court cases involve leukaemia, or other cancers, and most of the victims are destitute; the inevitable result of having lost employment and health insurance. Nevertheless, the nuclear industry has relentlessly pursued the loop hole which it saw in an earlier Supreme Court's ruling: that for expert testimony to be admissible in the court, its scientific basis had to be generally accepted in the relevant scientific community. Using this criterion, the nuclear industry challenged all the expert witnesses which the victims had found willing to assist them in their suit against the nuclear management which had caused the disaster. In pre-trial hearings, the nuclear industry managed to have the court eliminate almost all of the victim's expert witnesses. The nuclear 'experts' who work for this industry were considered by the court to be the "relevant scientific community", and only the documents produced by nuclear promoters such as the International Atomic Energy Agency (IAEA) as "authoritative".

It is good to remind ourselves that all this has happened in the United States-a country which prides itself as the home of "freedom and democracy". After this it should come as no surprise to victims of Bhopal, that their sufferings are not heard and the few crumbs thrown as "compensation" are all that they are going to get from relying on the conscience of the corporate tycoons and their Indian collaborators. In Bhopal the bodies of the victims lined the streets and (he disaster was apparent to everyone, but in a radiation accident

By use of very restrictive definitions, most of the illnesses and health problems which are actually experienced by the victims of a disaster like Chernobyl are not counted

like Chernobyl where death stalks slowly over the years, revictimisation means that victims are not recognised as victims at all. Thus, while the Ukrainian health ministry says that 125,000 people died due to the accident, IAEA still sticks the ridiculous figure of 28 deaths.

This jugglery is done through restrictive definitions of dose and risk. Thus, distinction is made between dose due to the "accident" and doses due to clean-up. For example, the dose may be defined as only that received in the first seven days, and even that amount will be reduced by the dose expected to have been received in the course of normal operation of the reactor. Death due to radiation exposure requires a dose estimate for • the victim above the threshold and death must occur between the exposure and 30 days thereafter.

Similarly, radiation detriment to health is divided into two categories:

Deterministic effects of radiation: This category of damage is considered to be evidenced by radiation burns and acute radiation sickness, such as was experienced by the firemen at Chernobyl. Detriment is based on the overall effect to the group, not the individual. Any effect not felt by everyone in the group, is classified as reversible, transient and of no concern to the group and hence not included in the detriment.

Stochastic Effects of Radiation: these include those effects which occur with statistical regularity in the exposed population such as cancer and genetic effects. These have no threshold. In order to ensure that these are radiation induced, nucleocrats recommend not counting any which have not had a "normal" latency period which is ten years for most cancers, and are not severe genetic effects in live-born offspring. Radiation promoted cancers arc not recognised as radiation related. Genetically damaged offspring who die in ulero are said to be of no concern to the community since they do not cost the community financially.

By use of these very restrictive definitions, most of the illnesses and health problems which arc actually experienced by the victims of a disaster like Chernobyl arc not counted or do not exist for the nuclear promoters. Automatically excluded arc: direct damage to tissue which results in altered biological function, like changed blood parameters, hormone or enzyme production, etc. Most evident in exposed children; embryonic and foetal death; genetic diseases not deemed "serious" like asthma, teratogenic damage including mental retardation, epilepsy, bone deformities, blindness and deafness, radiation promoted cancers which are clinically diagnosable in less than ten years after the disaster and autoimmune diseases.

With such preparation, is it any surprise, that the IAEA meeting on "Ten Years of Chernobyl" found that the disaster had had no consequence at all and recommended that governments of the region move people back to contaminated land?

Surendra Gadekar

Fighting for the straps

When International Atomic Energy Agency (IAEA)inspectors visited Bulgaria's Kozloduy station in 1991, they encountered missing stairway steps and gaps in walkway gratings. One inspector fell through a hole, bruising his leg. Railings around pools were missing, as were light bulbs and fixtures. Windows were broken, pumps leaked steam, and pools of oil and water were everywhere.

Western nuclear vendors could easily imagine that a serious nuclear accident in Central Europe or the Balkans would spread fallout over the major population centres of Europe, and they decided something should be done. At a June 1992 summit, the G7 industrial nations organised emergency measures to reduce near-term safety risks and to assess the feasibility of closing down the most dangerous Soviet-style RBMK-1000 and other VVER-440 reactors. The loss in generating capacity would be balanced by improved energy-use efficiency and alternate energy sources. Western nations, the European Union, the IAEA, the Organisation for European Cooperation and Development, and the European Bank for Reconstruction and Development (EBRD) pledged more than $785 million to improve safety RBMK-1000 and VVER-400 and -230 units. But five years later the only reactors to have been shut down are those inherited by the newly reunified Germany. Elsewhere in Eastern Europe, closure of the most dangerous and accident-prose reactors has been delayed indefinitely, although safety has improved at some plants.

I *Wanna Hold Tour Hand*

Western nuclear suppliers got a new lease on life with orders for everything from training support to new instrumentation and control centres and waste-storage buildings.

Ironically, Western-funded short-term safety improvements have encouraged the continued operation of the most dangerous reactors-at places like Kozloduy, Slovakia's Bohunice, Chernobyl , and Russia's Kola. Meanwhile, Western contractors like Westinghouse and Siemens have forged links with Eastern Europe's state-run utilities, most of which operate as subsidiaries of state energy ministries.

In 1993, Westinghouse invited four high Ukrainian energy officials to tour US reactors and discuss the possibility for joint completion of unfinished Ukrainian plants. ."We are children in the world economy, but we know what needs to be done," the head of Ukraine's parliamentary committee on science and technology, Pavel Kislyi, told *Energy Daily*. "We need a company like Westinghouse to hold our hand."

Nuclear colonialism?

Now most countries in the region are planning to extend their nuclear generating capacity, either by purchasing new Western-designed plants or by completing reactors left unfinished under communism. Last January, Atomic Energy of Ganada completed the first of the five reactors that were planned at Cernavoda. Westinghouse is working with the Czech utility CEZ to complete two Soviet-designed VVER-1000 reactors at Temelin, near the Austrian border. Electricite du France and German utility, Bayernwerk, had planned to complete Slovakia's unfinished Mochovce plant, which is equipped with second generation VVER-440s. Ukraine has conditioned the closure of Chernobyl on a wide-ranging package of Western aid designed to help Ukraine update its power systems, and finish three VVER-1000s. Hungary, Bulgaria, Poland, and Lithuania are all considering expanding their nuclear capacity, and Russia has announced a plan to double nuclear power generation by the year 2010.

Western governments are supporting these plans by providing loan guarantees. The US Export-Import Bank has committed $317 million for Westinghouse's work at Temelin; Canada loaned $270 million for the Cernavoda project; and, at one time, the EBRD had promised DM 700 million to Mochovce. By 1993, Friends of the Earth, an environmental group, reported that Western governments and institutions had committed twice as much money to completing unfinished Soviet-style reactors as they had to improving safety at operating reactors.

Because so many Eastern countries lack the financial resources to pay for their new nuclear capacities, building loans may be paid off by exporting some or all of the electrical output. For instance, Hungary has invited bids for 2000 megawatts of new capacity-twice its projected need. A West European partner could receive deliveries of electricity without the risks of operating, fuelling, or decommissioning the generating plants. Such a plan would also allow a West European government to dodge the public opposition to nuclear power that has suffocated most Western programs.

Meanwhile, the Eastern partner would be responsible for operational and incidental costs, including the costs of fuel and waste disposal, new transmission lines, and hundreds of power plant employees. At the end of the plant's lifetime, the Eastern partner would have to bear the costs of decommissioning, which alone can add at least 3Q percent to the initial cost. Not just construction, but many of the "downstream" activities would require the services of Western consultants and suppliers.

"It's one of the last markets in the world for the Western nuclear industry," says Paxus Calta, an anti-nuclear campaigner for the Vienna-based environmental group Global 2000, who believe that Western and Eastern nuclear interests have formed an unholy alliance.

"The Eastern nuclear establishment is very interested in maintaining their monopoly power, avoiding privatisation, stopping market reforms, maximising profits, and maintaining the options for kickbacks and corruption."

Communist party planners turned to nuclear power as the basis of their long-term energy strategy in the mid-1970s, when the price of Soviet oil and gas increased. Bulgaria was to have more than a dozen reactors by 2005; Czechoslovakia, 30; Poland more than 20; and Hungary and Romania, half a dozen each.

Some of these projects were never started, but of the others, many plants were left unfinished. Millions-sometimes billions of dollars have been invested in them. The engineering and professional organisations that would have built, operated, and supplied the reactors-big firms like Skoda-Plisen, Russia's Atomenergo-export, and even smaller ones like the Vatra Dornei uranium mines in Romania-have a great deal of political influence.

And the organisations that, operates the existing reactors that provide 80 percent of Lithuania's electricity needs, half of Slovakia's and Hungary's and a third of Slovene and Bulgarian supplies, wield commensurate political leverage within the energy sector.

Double Standards

The main break on Western suppliers' enthusiasm is the issue of liability. Most East European countries have not yet signed the Vienna Convention, which holds the operator, not the supplier, of a nuclear facility responsible for damages in case of accident. Western suppliers do not want to be liable for billions of dollars if a plant they help to built suffers a serious accident. "It's a pressing issue for them," says IAEA spokesman David Kyd. "Until the liability issue is resolved, their legal departments are advising against involvement."

Completing of retrofitting Soviet-designed plants carries an extra degree of risk. Western assistance to complete Temelin and Mochovce has raised the issue of a double standard for reactor safety. A newly reunified Germany acted quickly to close the VVERs at East Germany's Griefswald plant, which were deemed unsafe and not upgradable. As late as 1995, however, the EBRD, Electric de France, and Bayernwerk were helping to complete Mochovce's reactors, which are identical to those at Griefswald.

Bayernwerk head Wild admitted in a 1994 newspaper interview that a plant like Mochovce could not be operated in his country: "Certainly no one would permit this kind of installation in the. surroundings of Munich." Similarly, Germany concluded that the nearly completed VVERs at Stendal could not be brought to acceptable safety levels, and that plant-which, paradoxically, is identical to the facility at Temelin in the Czech Republic-was also decommissioned. Meanwhile, backed by US government loans, Westinghouse is completing Temelin.

One problem with VVER-440 series reactors like those at Mochovce is there lack of containment. Experts interviewed for this article-including the head of nuclear safety research at a US Energy Department laboratory and the Canadian site manager at Cernavoda-agree that it is not feasible to backfit the reactor with containment, and that without such a structure, these plants would not be allowed to operate in North America. Temelin and Machovce-both less than 100 kilometers from Vienna-have been opposed by Austria, which has waged a stormy campaign against projects that it considered unacceptable risks to its citizens. Austria's threat to withdraw from the EBRD over the issue contributed to the bank's decision to abandon financing Mochovce.

Waste Not Want Not

Safety issue aside, mounting evidence suggests that nuclear power is not the solution to the region's energy needs. "We have an extremely energy-intensive economy, and we already have surplus generating capacity," says former Czech Environment Minister Bedrich Moldan. "If you have such a big investment as Temelin, it will [deplete]the limited resources available for addressing the outrageous inefficiencies in our energy system."

"The Eastern nuclear establishment Is very Interested In maintaining their monopoly power, avoiding privatisation, stopping market reforms, maximising profits, and maintaining the options for

corruption"

There's plenty of room of for demand-side improvement. By subsidising energy and raw materials, and driving for increased industrial production, communist planners created a system plagued with waste and inefficiency. Poland uses two to three times as much as energy for the same output as West European countries; Romania, three to five times as much. Electricity is produced, transmitted, and consumed in a wasteful manner-homes lack thermostats, buildings and heating ducts are improperly insulated, and antiquated machinery and power plants squander vast quantities of energy.

"There is enormous potential for energy efficiency gains," says Diana Vorsaz, a Hungarian energy expert at Central European University's

environmental science department. "It's absurd to try to address the problems in our energy sector through increased supply. Demand can be reduced at a fraction of the cost while improving our economy and competitiveness." Vorsatz estimates that as. much as a third to a half of current consumption could be saved.

However, even if the West should decide not to help complete questionable plants, Russia may. After the EBRD abandoned Mochovce last year, Russia's Minatom stepped in. Slovak officials have backtracked on their pledge to close older, more dangerous units at Bohunice, and they have grown weary of Western scrutiny of safety upgrades and least-cost studies. Russia and a consortium of Czech banks are offering to help complete Mochovce at a fraction of cost.

A recent study by Centre for Strategic and International Studies warns that Minatom is emerging as an aggressive exporters, citing Russian activities in Iran, Cuba, and India.
Belarus may choose. Russia's Soviet-style reactors because they are less expensive than Canada's CANDU-6. Meanwhile will successfully market its plants in China

It looks like nuclear power plant inspection will be. a growing field.

By Colin Woodard
Bulletin of Atomic Scientists May June 1996

The Belarussian Necklace

Four frightened young girls
Waiting for their turn
Will it hurt? Will I survive?
The lessons quickly learned
They lie there in their beds of fear
It could be you or me, but they must
pay the price
For man's inhumanity.

Four frightened young girls
Want to live their lives
Want to find a sweepheart
Want to be young wives.
They want safety for their children
In a land that's free from fear
They. want to love and life and laughter
And a future they can face
With their children's necks unblemished
Not a Belarussian red necklace

Mags Whiting

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